Handling a 100,000-Kw. Boiler Plant*—*Use of Iron Wire for Transmission Lines, and other articles featuring station and operating practice.

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Electrical World

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Eric Gerard

IT is with great regret that we learn of the death of Dr. Eric Gerard, the Director of the Montefiore Electrotechnical Institute at Liège, Belgium, and professor in the University of Liège. Professor Gerard was for many years one of the foremost electrical engineers and professors of electrical engineering in Belgium. He represented Belgium at the International Electrical Congress of Chicago in 1893 and of Paris in 1900. He was also president of the Belgian committee of the International Electrotechnical Commission. As the director of the Montefiore Electrotechnical Institute, he had a great influence on the training of electrical engineers in Belgium, and many of the prominent men in the Belgian electrical engineering profession are his students.

Professor Gerard was the author of several electrical text-books, at least one of which was translated into English and published in America. His writings were always notable for their clearness and purity of literary style. They were also remarkable for the range of subjects which he covered. He had many warm friends and devoted admirers in the United States, as well as in all the countries of Europe. A hard worker, an earnest student, and a loyal comrade, his kindly presence will be sadly missed at international electrical engineering gatherings.

An Important Transmission for Coal Mines

THE plant of the Consolidation Coal Company, supplying a widespread territory in the West Virginia coal mining region, is of far more than usual interest, furnishing somewhat wide departures from the usual plants of the "favorite prescription" type. For certain work of the coal-mining industry direct current is required, while three-phase motors can be utilized for the remainder. The distribution in this case, therefore, involves the use of substations with both stationary and moving apparatus, with a moderately high transmission voltage. The main generating plant at Hutchinson, W. Va., is altogether exceptional in that it is a gas-engine outfit utilizing natural gas. At the substations two general features are somewhat notable. First, the designers of the system were not afraid to use 60-cycle synchronous converters at every point where direct current was necessary. The time has long passed when engineers need to be afraid of 60-cycle converters, in spite of somewhat unpleasant experiences with the early units of this class. Second, all the transformer substations are of the outdoor type, erected on rectangular steel towers about 20 ft. high and provided with open-air horn-gap switches and protective apparatus of similar type. It has taken a long time for experience to enforce the lesson that outdoor substations are thoroughly practicable, and that for moderate amounts of energy and voltages there is little need of going to heavy, intricate, and expensive switching apparatus. The synchronous converter substations are under cover, as must generally be the case, but the outdoor construction for all other substation apparatus means not only low cost, but extremely easy inspection and greatly reduced fire hazard.

Uniformity in Valuations

THE first important electric valuations began in 1907. In the nine years following central station property, worth upwards of $300,000,000, has been valued for various purposes, but, as yet, no standard nomenclature or uniform methods of doing the work have been recognized either by the commissions or the companies. Heretofore, in all discussions of the subject, the intricate legal questions involved have overshadowed the purely technical engineering problems. We believe that the time has come when the legal problem should be at least temporarily set aside, and the attention of the industry should be directed toward solving the real engineering and standardization problems involved. In a recent case, the commission, the city and the company each made separate valuations. In the testimony it was necessary to compare one with the other, and while the valuations were based upon practically the same inventory, in each case the conception of what constituted "overhead charges" so differed that each engineer spent months in making a painstaking analysis of the other valuations, in order to reach a real comparison. Such unproductive effort is not only wasteful, but the standardization of the term "overhead charges" would have prevented much difficult and unnecessary work.

Some years ago one of the commissions attempted to standardize the field sheets for inventory work, and these were used to quite an extent in the early valuations. Each engineer, however, with experience develops certain modifications, not only of the forms but of the methods used, and to-day the standardization of inventory work might well take place, not in the design of the form for field notes, but in the manner in which the results are arranged in the final sheets. A general uniformity in this respect would be very useful, as the specialist in valuation work is often called in a consulting capacity after the inventory has been finished.

The experience of the various valuation engineers is to-day so extensive that much progress can be made in such standardization work without in any way crippling

proper initiative, and the development of economical and efficient methods of field and inventory work on the part of the individual engineer. The standardization of the terminology used in valuation work would again be of great service in enabling engineers to talk, and the commissions and courts to understand, the same language in valuation testimony. The lack of such uniformity has apparently puzzled many of the newer commissions, and often the record is filled with needless explanations and descriptions, so that the real purport of the testimony is confused, if not altogether lost. Any effort toward such standardization should be welcomed, and should receive the co-operation of all of those interested in the valuation of electric light properties. Here is a piece of work which is within the scope of the activities of the associated public utilities. A representative committee of the National Electric Light Association should undertake this important work.

Iron Wire for Distribution and Transmission

WE present this week reports of the tentative work done by ten operating companies in the substitution of iron wire for copper for various minor uses in their service. With copper at normal prices there is comparatively little temptation to use iron wire on account of its greater resistance and reactance. When, however, the price of copper is double its normal value, to which approximate figure it has risen within the past year, the question of a cheaper metal for conductors acquires some significance. Especially is it to be noted that the various companies experimenting along this line have utilized iron wire not for main transmissions, but for minor work where the length of the lines was considerable with respect to the load carried.

When considering the use of wire for more considerable circuits, especially circuits of moderate length carrying a light load, the work of various companies indicates that entirely satisfactory results can be reached with iron, provided the load does not increase to a point where the drop becomes unduly burdensome. Reference to the diagrams of losses, real and apparent, will readily show the reader the kind of limitations which are met.

As regards general conditions of service there have been some reports of additional disturbances on the line chargeable to branches of iron wire. This might naturally be expected since there is a rather sharp discontinuity in the constants of the line at such a point of junction. Whether in the ordinary case it would be materially more severe with iron than with copper is somewhat doubtful. Theoretically it might be, but whether the difference would be of practical moment is quite another question. No general attempts have yet been made to use iron conductor on any transmissions of serious magnitude, and it seems somewhat doubtful whether it would be worth while unless in the development of extremely cheap power under conditions where the scattering of the load would force an exceptionally great amount of line cost per kilowatt-hour sold. Even under these special conditions there is little likelihood of sufficient difference in the cost of copper and of iron being maintained to justify the substitution. As a temporary expedient for small work it may be worth while so long as the price of copper remains near its present high figure, but the data do not yet indicate any permanent place for iron line conductors. In the long run investment costs and rates of interest tend to go lower rather than higher, and a continuing loss like that of energy is likely to overbalance any non-permanent small economies of construction which depend on temporary rather than average prices of material.

Handling Boilers in a 100,000-Kw. Station

FROM the article in this issue on the operating methods used in the boiler plant of the Boston Edison Company in South Boston, Mass., it is evident that in that central station the "electrical end" of the establishment has no monopoly on scientific management. Successful steam production on a big scale to-day in a plant like that at L Street is in no small degree controlled by staff organization. The day has passed when indifference to what goes on behind the fire wall so long as the steam pressure holds up can be justified for a single hour. In the systematization of work in vogue in this most important individual station of New England, plants of lesser size will find much for study. "Preparedness" has long been the motto in handling this installation, and in the assignment of inspection duties, the forecasting of repair tasks, anticipation of visits by insurance representatives and general efficient handling of steam-generating units, one observes a grasp of responsibilities which would be difficult to excel.

Of the details that show thoroughness in operating practice, the inspection rules outlined in the article speak most convincingly. In numerous steam plants there is a natural tendency for owners and their employees to rely mainly upon the insurance company's engineers and to make rather superficial inspections, confident that the microscopic eye of the outside expert will locate every preventable fault. This attitude is not maintained at the Boston plant, where every boiler is regularly gone over with an eye keen for details. This work is done before the insurance inspector's arrival, and long enough in advance, in fact, to enable every fault which can be discovered to be remedied before the official examination begins. The lesson in this procedure for steam producers tempted to neglect the physical condition of their boiler plants ought to be clear, for it is impossible to present a better example of the proverbial "stitch in time." This inspection not only forestalls operating troubles which, if allowed to remain, tend to become cumulative, but sets a standard of plant maintenance that insures the best possible use of the equipment because of the familiarity of the boiler-room executive with its most intimate details. In the attention paid to routine inspection and daily maintenance to the economical handling of the combustion processes, and to the almost military precision of labor assignments, a high plane of steam plant practice is reached

and sustained. The liberal use of recording instruments in the "steam end" of the station and the continuous expert study of operations which the company's administrative officers and laboratory branch staff constantly bring to bear are also important factors in the reputation of the station for service of the first order.

Danger in Overreaching

MUCH of interest and of profit can be gleaned from the history of the railroads and railways of the country, and of the troubles which now beset them. Not all transportation companies are managed by men of ripe experience and sound judgment, who, being neither pessimistic nor unduly optimistic, have built just to keep abreast of developments and no more. Too often the railroads and railways have listened to the voice of the promoter, and have been beguiled by the charms of the real estate speculator so that the roads traverse a barren wilderness or extend into uninhabited sections. The successful railroads and railways have grown with the communities they serve. As the population increased so did the facilities for handling it, but seldom in like proportion. Such anticipations of traffic as were made were based on developments and not on hopes, with the result that depressions rarely exercised a baneful influence on earnings or curtailed service. The conditions confronting the light and power companies are not so serious as those which confront the transportation companies; but there are lowering clouds in the horizon.

The nation has grown rapidly, chiefly through immigration; but war has checked the tide, and even reversed it. Barring the Pacific Coast the country as a whole is still undeveloped electrically, so that there is yet abundant opportunity for expansion. However, considering all the conditions, the wisdom of henceforth building in advance of the market is open to question. It is true that many recent hydroelectric plants were erected in that way, but most of them have come to grief and passed through receiverships or were forced to buy in other properties in order to get a market for their outputs. With a limit now being placed on earnings by public service commissions, it behooves managers of properties to exercise prudence and make sure that in canvassing for wider markets they do not overreach. There is a limit beyond which profit ceases and charity begins. Electric railways now realize that there is very little money in long hauls, and lighting companies may likewise soon discover that miles and miles of line in sparsely settled territory are a burden to the flesh and nothing more. The blocks of houses which are passed by circuits extending into the suburbs may not be so undesirable as a load if given a little thought. Not that there is less profit in the suburbs, but because there may be greater profit in the heart of the city. Besides, it is not the function of private capital to go out into the highways and byways in search of business which is now at its very doors. It is very hard for a utility to retrench; it is much easier not to over-expand. The temptation to do the latter, however, is very strong, and should be combated. Intensive cultivation on existing circuits should be the order of the day.

Temperature Characteristics of Tungsten Filaments

OUR Digest refers this week to a recent paper by Dr. Irving Langmuir, in the *Physical Review*, on "The Characteristics of Tungsten Filaments as Functions of Temperature." In this paper a number of experimental observations concerning the radiation from tungsten filaments, at various temperatures up to 3540 deg. in the absolute or Kelvin scale, or 3267 deg. C., are collected and discussed. Incidentally, the use of the symbol degree *K*, as representing temperatures on the Kelvin scale, seems to be both convenient and distinctive. It is fitting that some nominal recognition, in the way of thermal units, should be given to Lord Kelvin's name, especially in view of the large contributions which he made to the science of thermodynamics.

The article points out that there is a close correspondence above the temperature of 1800 deg. *K*, between the measured brilliancy of the tungsten filaments tested, and their computed total luminous output. The mean ratio represents 827 international-candle lumens per watt of luminous radiation. The constancy of this ratio, over a wide range of high temperatures, is not only a good check upon the photometric observations; but is also a confirmation of the values accepted for the emissivity. It corresponds to about 66 mean spherical candles per watt. On this basis, it is easy to see that there is still a very wide range for possible improvement in the luminous efficiency of light sources.

It is also interesting to observe that the light emitted by the tungsten filaments under test was distinctly bluer than that of a perfect radiator, or "black body," and that a color match would require the black body to be at a temperature from 40 deg. to 80 deg. *K* higher than the tungsten.

The Coming Issues

IN the engineering number for April, which appears next week, an article deals with possible simplifications in the design and construction of an outdoor substation, as exemplified in an installation recently completed. Engineering details in connection with the construction of high-tension cable joints, and the performance characteristics of commercial series transformers are subjects of other articles in this number, which will also include the regular departments on operating and commercial practice. In the commercial issue dated April 22, which follows, some of the recent interesting manifestations of the general movement toward electric cooking in the household will be treated in detail. Other articles of particular central-station interest will relate to the broad fields of motor applications, electric signs, household devices for spring business, etc., and there will be subjects of special interest to the electrical contractor, the dealer, the jobber and the manufacturer.

Chronicle of Events of the Industry and of Important Movements in the Field

NEWS OF THE WEEK

Reports of Conventions and Meetings of Electrical Associations and Societies

A. I. E. E. and A. E. S. to Hold Water Power Conference at Washington

A meeting of the American Institute of Electrical Engineers will be held at Washington, D. C., on Wednesday, April 26, 1916, under the auspices of the Washington section and the committee on development of water power.

Headquarters will be at the New Willard, and through the courtesy of the hotel management ample facilities have been put at the Institute's disposal. Two sessions are to be held, the first beginning at 2.30 o'clock in the afternoon and the second at 8.15 o'clock in the evening, both devoted to the specific question of water-power development as related to national industrial efficiency and preparedness.

The appointment by the President of the United States to the Naval Consulting Board of men nominated by the national engineering societies, and the President's subsequent invitation to those societies to co-operate by recommending engineers who should assist in making an inventory of national resources, indicate a broadened field of useful service to our country which the members of the engineering fraternity as a body can perform.

The forthcoming meeting has been suggested by the committee on development of water power, which sees a further opportunity for service to the nation by directing the attention of the public and of Congress to the fundamental engineering and economic principles that underlie the water-power question and which must be taken into account if hydroelectric development is to be encouraged and stimulated, with a corresponding effect on the development of the great electrochemical and similar industries which are essential to the industrial independence of the nation.

At the present time Congress is considering the enactment of legislation intended to remove some of the legal obstructions which in the past have operated to deter capital from investment in hydroelectric enterprises, and it would therefore seem to be a peculiarly opportune moment for the Institute to be of service. As will be noted from the program which follows, it has been sought to correlate several of those phases of hydroelectric development which are of peculiar and perhaps unusual importance at the present time, while the standing of the authors who have consented to prepare the several papers insures a thoroughly adequate presentation.

The program for this meeting, as at present arranged, is as follows: Address by President John J. Carty; "Electrochemical Industries and Their Interest in the Development of Water Power," by Lawrence Addicks; "Water-Power Development and the Food Problem," by Allerton S. Cushman; "The Relation of Water Power to Increased Transportation," by L. B. Stillwell; "The Relation of Water Power to the National Defense," by Dr. W. R. Whitney; "The Water-Power Situation, Including Its Financial Aspect," by Gano Dunn.

On Thursday, Friday and Saturday of the same week the American Electrochemical Society will hold its annual meeting in the same place. One session will be given over to papers on the water-power problem of Niagara Falls and the importance of the electrochemical industries there to the industrial life of the country.

The program for Thursday's sessions of the American Electrochemical Society which are of chief interest to electrical engineers follows: Symposium—Co-operation in Industrial Research; Lawrence Addicks and F. A. Lidbury, "The Professional Society"; Drs. W. D. Bancroft and W. H. Walker, "The University"; D. A. Lyon, "The Government"; Drs. L. H. Baekeland, and W. R. Whitney, "The Corporation." The following papers are also scheduled for the morning session: "The Detectors in Wireless Telegraphy," by W. D. Bancroft; "Hydrogen for Military Purposes," by E. D. Ardery; "Liquid Chlorine," by G. Ornstein; "Magnesium," by Dr. W. M. Grosvenor.

A symposium on water power is scheduled for the Thursday afternoon session and the program arranged is as follows: "Niagara Falls Power and American Industries"; (1) "The Power Development," by I. R. Edmands; (2) "Electric Furnace Products," by F. J. Tone; (3) "The Chemical Industries," by A. H. Hooker; (4) "The Nitrogen Question," by W. S. Landis. This symposium is to be followed by an illustrated address on "Reclamation Service Water Power," by Director A. P. Davis, chief of the Reclamation Service. In the evening there will be an illustrated lecture on "Water-Power Development for Electrochemical Purposes," by H. J. Pierce.

Military Preparedness Receives Attention of Chicago Engineers

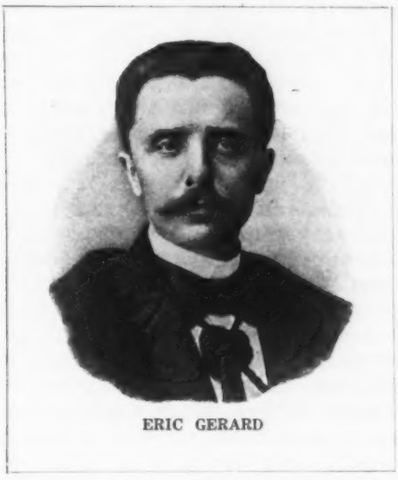
At the meeting of the Engineers' Club in Chicago on March 25, a joint committee on military engineering was formed for the purpose of furthering military preparedness among engineers by a course of lectures, assigned readings, studies and practical instructions in military engineering, and arousing interest generally in this branch of the nation's defense. A program has been arranged for one event a week beginning April 20, when Lt.-Col. W. V. Judson, Corps of Engineers, U. S. Army, Chicago, will open the series with an address on "The Civilian Engineer and National Defense—Organization and Duties." On April 27, Major P. S. Bond, Corps of Engineers, U. S. Army, Cleveland, will give an illustrated lecture on "Service of Reconnaissance and Demolition," and on May 4, Col. Mason M. Patrick, Corps of Engineers, U. S. Army, Detroit, will talk on "Coast Defence." By this time it is anticipated that outdoor work will be feasible, and an exhibition drill in bridge and pontoon building by the engineer company of the Illinois National Guard will be arranged. Raymond Sheldon, Eighteenth Infantry, will conduct a tactical walk and defense problem on May 20. Other events of like nature have been scheduled until July 25, with a correspondence course and practical work to be organized during the summer.

On April 1 the following directors were elected in addition to Wharton Clay, chairman, who had been chosen at a previous meeting: Capt. Robert W. Hunt, vice-chairman; Robert F. Hall, secretary-treasurer; Bion J. Arnold, W. W. DeBerard, J. De N. Macomb, Jr., H. S. Baker, Robert I. Randolph and Vernon C. Ward, Jr.

Death of Dr. Eric Gerard

Dr. Eric Gerard, one of the best-known professors of electrical engineering in the world, died on March 27 at Paris, France. Dr. Gerard was a native of Belgium, and for thirty years taught in the Montefiore Institute at Liège. He was at Petrograd, Russia, when the Germans attacked and captured Liège, and having determined never to return to Liège as long as it was in the hands of the Germans, he made his abode in Paris and in London. Dr. Gerard had the distinction of being the first person to teach electrical engineering as a separate subject.

Eric Gerard was born in Liège, Belgium, on Sept. 22, 1856. He was educated in the Belgium schools, and graduated from the School of Mines in Liège in 1878. Entering the Belgium Telegraph Department he was



ERIC GERARD

sent to Paris for further study, and returned in 1881 to Liège as secretary of the Belgium section of the exposition, and in the same year was appointed secretary of the International Congress on Electrical Units. He succeeded DeLarge to the chair of telegraphy and other applications of electricity in the School of Mines at Liège, and when Senator Montefiore founded, in 1883, the Institut Electrotechnique Montefiore in Liège, Dr. Gerard was chosen as its director, and occupied that position up to the time of his death. He organized its laboratories and devised many electrical instruments and methods of measurement. As a teacher Dr. Gerard was greatly beloved. The Montefiore Institute, it might be of interest to mention, gives one and two-year courses in electrical engineering, and Dr. Gerard's later title on the faculty of the University of Liège was professor of electrical technique. He was also inspector general of telegraphs for Belgium.

As a writer, Dr. Gerard confined himself to technical subjects, which he handled with marked literary ability and a special skill and clearness. His more important volumes were the outgrowth of lectures to the students, and include "Lessons on Electricity in Magnetism," which has been translated into English, Russian and Servian, the American edition bearing the date of 1897; "Electrical Measurements," "Elements of Electrical Technique," and "Electric Traction," the latter a volume of 1900. Since that time the attention of this versatile scentist had been turned in part to processes for plotting curves by photography. Some hundreds of pamphlets and brochures were written by Dr. Gerard. He was one of the founders of the International Electrotechnical Commission and president of the Belgium committee of that organization. He was a visitor to the United States as the Belgian representative to the Electrical Congress in Chicago in connection with the fair, and made a tour of the country, winning many friends. He was a delegate also at Paris in 1900. In recognition of his work, the following distinctions were conferred on him: Cross of the French Legion of Honor, Order of the Iron Crown of Austria, an officer of the Crown of Italy, a chevalier of the Order de Leopold (Belgium). When the last distinction was conferred on him his friends and pupils formed a committee and gave him a great ovation. He leaves a widow and a son.

Illumination Lecture Course at the University of Pennsylvania

In the fall of 1910 Johns Hopkins University, jointly with the Illuminating Engineering Society, gave a notable lecture course at Baltimore on subjects relating to gas and electric lamps and illumination. This was an affair entirely different from the usual engineering society conventions, and formed a new departure for the society. It was referred to as the lectures on illumination under the joint auspices of the University and the Illuminating Engineering Society, and was participated in by many of the foremost chemists, architects, ophthalmologists, physicists and engineers of the country.

This course has been looked upon as one of the most important undertakings in the history of the Illuminating Engineering Society. A tuition fee was involved and very elaborate experimental equipment was installed and in operation under the care of experts. The attendance exceeded expectations and was sufficient to meet the entire expense of the plan, so that from every standpoint it was a success.

At the present time the published records, in the form of two volumes, are rare and they are still in demand. Furthermore, the art and science of electric and gas lighting have made such rapid progress that for the second time the Illuminating Engineering Society, under the leadership of Dr. Charles P. Steinmetz, has decided to hold a new series of lectures in September, 1916. This proposed event is to be held at the University of Pennsylvania.

In the interval since 1910 many changes have taken place in the lighting field. New lamps have been developed and new methods of lighting introduced. The present plan is to repeat in a general way the previous lecture course of five years ago, treating mainly those subjects which have come to the front in the meantime. It is probable that the new volumes may also contain as many of the old lectures as can be classed fundamental, with slight revisions to bring them up to date.

A very interesting characteristic of the 1910 lecture course was its relation chiefly to illumination as a science rather than as an art or a branch of applied engineering. For this reason it has been planned to devote most of the next course to engineering aspects of illumination. This should insure a most practical collection of topics of special value to practicing engineers.

Early in 1916, when it was first thought probable that a new lecture course might be considered, a tentative invitation was extended to the council of the Illuminating Engineering Society by the University of Pennsylvania to stage the lectures at the university. It seemed to the university authorities that an affair of this kind would be advantageous both to the society and to the university, and Philadelphia was suggested as a convenient location, as the university facilities are exceptionally well adapted to the lecture course and the extensive exhibits of lighting appliances which will accompany them.

After the society had adopted a definite resolution to

conduct such a lecture course, Provost Edgar F. Smith of the university transmitted a formal invitation to President Steinmetz, which was accepted. Two main committees of the society and one of the university have charge of this affair. For the society, the administrative committee on lectures is composed of Preston S. Millar as chairman, and Prof. C. E. Clewell, J. D. Israel, Dr. A. S. McAllister, W. J. Serrill and G. H. Stickney; the committee on lectures is composed of Dr. E. P. Hyde as chairman, and Dr. Louis Bell, W. H. Gartley, L. B. Marks, Dr. C. H. Sharp and W. D. Weaver. For the university the following committee has been appointed: Professors Harold Pender and C. E. Clewell, electrical engineering; Dr. G. E. de Schweinitz, ophthalmology; Prof. W. T. Taggart, chemistry; Prof. W. P. Laird, architecture; Prof. R. H. Fernald, mechanical engineering; and Prof. A. W. Goodspeed, physics. Subsequently a local honorary committee will be appointed.

The annual convention of the Illuminating Engineering Society will be held in Philadelphia immediately preceding the lecture course, and the latter is scheduled at the university from Sept. 21 to 30.

Classification of Technical Literature

Joint Committee of National Engineering Societies Discusses Means of Codifying All Contributions on Applied Science

A meeting of the joint committee on classification of technical literature was held in New York City on April 1, at which methods of carrying on the work signified by the committee's name were discussed. Two general schemes of procedure were considered: One is to assign different parts of the classification to organizations most vitally interested therein, the final compilation and correlation of material to be performed by one central body under the supervision of an expert classifier; the other method is to have classifiers or librarians intimately acquainted with present technical literature prepare classifications subject to revision by engineering organizations. The first scheme received the most support. Dr. Samuel Sheldon, delegate of the United Engineering Society, contended that engineers are more qualified to classify the literature interesting them than are professional classifiers, because the former are more intimately acquainted with its detailed ramifications. Since the various organizations which are in existence at present are comprised of some of the best authorities in the country on the subjects covered by them, these societies should be able to prepare the most comprehensive and representative classifications. Furthermore, by being asked to originate the classifications the organizations will be more liable to adopt the final draft than if the classification is a one-man work on which they are only permitted to give suggestions.

Prof. Edgar Marburg, delegate of the American Society for Testing Materials, expressed similar views, and added that if the task of classification is apportioned among societies, each of these may appoint from its midst a member, who should in turn prepare his own campaign and secure the necessary assistance to do the detailed work. The supervisory head in each organization, he pointed out, should preferably be a "crank" on the subject of classification, so that the necessary impetus or enthusiasm will be imparted to the movement to make it successful. It was also suggested that all persons engaged in the classification should live in New York in order that the undertaking can be expedited by occasional joint meetings.

Otto K. Swingenberger, representing the Roessler & Hasslacher Chemical Company, Perth Amboy, N. J., also favored this method of procedure, and outlined the method he would follow if called upon to supervise any branch of the classification. He expressed the belief that companies benefited by a standard classification would probably be willing to share the expense of preparing it since the benefit they would derive from its adoption would be invaluable. The speaker pointed out that the classification employed by the United States Patent Office should be a valuable guide in this undertaking. He also suggested that if the classification is apportioned among different organizations, provision should be made so that those classifying overlapping subjects can be acquainted with each other's work.

C. F. Clarkson, representing the Society of Automobile Engineers, called attention to the urgent need for standard classification in the automobile industry, and explained briefly a method attempted for standardizing automobile-part nomenclature. He expressed the belief that many classifications are unsatisfactory because they have been prepared by classifiers not fully acquainted with the subject matter they are correlating.

H. W. Peck, delegate of the American Gas Institute, pointed out that some organizations, seeing the need of standard classifications of literature, have been considering performing the work themselves, but are awaiting the action of the joint committee. He expressed the belief that considerable assistance can be secured from different company librarians who know the needs of their particular industries and the weaknesses of present classifications.

Dr. A. S. McAllister, representing the National Electric Light Association and the Illuminating Engineering Society, favored the second method of preparing the classification, *i.e.*, having librarians or classifiers prepare a tentative outline, which should be submitted to engineering organizations for revision. He pointed out that this would bring the quickest results, since many men will not take the time to originate anything, whereas they will revise material which vitally concerns themselves. He acknowledged that this method had certain disadvantages, however.

W. P. Cutter, delegate of the American Institute of Mining Engineers and librarian for the United Engineering Societies, expressed the belief that preparation of a classification by engineers and engineering organizations is doomed to failure since they are not fully acquainted with all the literature on any subject, whereas librarians are. To bear out his statement, he called attention to the inadequacy of classifications prepared in this manner by the British government. The outcome of the discussion was that the executive committee of the joint committee was instructed to acquaint itself with the attitude of different organizations in assisting the joint committee by originating classifications of literature of vital interest to them.

A list of the societies represented on the joint committee on classification of technical literature, with their delegates in so far as appointed, follows: American Ceramic Society, Prof. C. W. Parmelee; American Electrochemical Society, Dr. E. F. Roeber; American Institute of Architects, Sullivan W. Jones; American Institute of Mining Engineers, W. P. Cutter; American Institute of Electrical Engineers, Dr. F. B. Jewett; American Physical Society, E. C. Crittenden; American Railway Engineering Association, C. E. Lindsay; American Electric Railway Association, J. P. Ripley; American Society of Mechanical Engineers; F. R. Low; American Society of Civil Engineers, Charles Warren Hunt; Bureau of Standards, Department of Commerce, Dr. George R. Olshausen; Franklin Institute, Alfred Rigling; National Electric Light Association, Dr. A. S. McAllister; American Society of Heating and Ventilating Engineers, J. J. Blackmore; Society for the Promotion of Engineering Education, Dr. F. L. Bishop; Amer-

ican Society for Testing Materials, Dr. Edgar Marburg; American Foundrymen's Association, Dr. Richard Moldenke; Society of Naval Architects, William Binley, Jr.; American Society of Refrigerating Engineers, Dr. Frederick L. Pryor; American Water Works Association, Nicholas Hill, Jr.; Association of Railway Electrical Engineers, J. R. Sloan; United Engineering Society, Dr. Samuel Sheldon; Illuminating Engineering Society, Dr. A. S. McAllister; Society for Electrical Development, C. Clifford Kuh; American Gas Institute, H. W. Peck; American Society of Agricultural Engineers, George F. Weston; Society of Automobile Engineers, C. F. Clarkson; National Fire Protection Association, F. J. T. Stewart; Society of Chemical Industry, Otto K. Swingenberger; Aeronautical Society, Rudolph R. Grant; American Mathematical Society, Prof. E. V. Huntington; Society to Promote the Science of Management, John H. Williams.

H. W. Peck of the Schenectady (N. Y.) Illuminating Company is chairman of the committee and W. P. Cutter, librarian of the United Engineering Societies, is secretary.

New Jersey Public Service Corporation Report

The Public Service Corporation of New Jersey had a good year in 1915, according to its annual report. The gross revenue of the subsidiary companies reached a total of $37,471,228.24 which was an increase for the year of $1,781,395.34, or 5 per cent. During the early part of the year the increases in the revenues of the subsidiary companies were all small, due, it was stated, to the continued business depression and the European war. In the latter part of the year, however, the increases were decidedly better.

The operating revenues for the three major subsidiaries and their affiliated companies for the year 1915, with the amount of increase over the previous year and the percentage of increase for the year, are as follows:

	Operating Revenue	Amount of Increase Over Previous Year	Per-centage of Increase
Public Service Railway Co.	$16,569,443.28	$259,187.72	1.59
Public Service Electric Co.	10,425,851.78	1,132,190.28	12.18
Public Service Gas Co.	10,475,933.18	390,017.34	3.87

The corporation points out that the significant fact in the above tabulation is the enormous increase in the business of the electric company, the gross business of which has, for the first time, nearly equalled the gross business of the gas company. The gross revenue of the operating electric properties during the eleven years 1904-1915 increased from $3,502,811.92 to $10,487,281.33, or over 200 per cent, while during the same period the gas properties increased from $5,378,440.53 to $10,764,877.94, or 100 per cent.

The outstanding stock of the Public Service Electric Company now amounts to $22,000,000, of the Public Service Gas Company to $11,600,000 and of the Public Service Railway Company to $37,981,600, all of which, with the exception of twenty-five shares of the latter, is owned by the corporation.

The increase in output commercially sold by the electric company was 38,034,933 kw.-hr. or 23.91 per cent. During the year the gain in horsepower connected with the lines of the company was 32,940 hp. as against a gain of 23,491 hp. in 1914. Revenue from commercial power sales is now double the revenue from street lighting. Revenue from electric sales averaged 5.16 cents per kilowatt-hour sold as against 5.71 cents during the previous year.

Taxes for 1915 amounted to $2,316,965.91, an increase of $114,411. The corporation points out that while it has no inclination to avoid its fair proportion of the public burden, there is a limit beyond which taxes cannot go, whether assessed against individuals or corporations, unless there be a commensurate increase in revenue.

Expenditures charged to fixed capital account for the subsidiary companies during the year amounted to $8,301,220.74, apportioned as follows: $2,881,199.28 for the electric company, $814,666.16 for the gas company, and the remaining $4,605,355.30 for the railway company.

The company now has twenty-two stations for taking care of its railway and light load, 157 boilers, 156 generators, the total rating of which is 227,813 kw., sixty-one substations, 110 rotaries, the aggregate rating of which is 84,500 kw. The output for light and power was 197,079,581 kw.-hr. There was on the company's lines at Dec. 31, 1915, 13,878 arc lamps and 24,803 incandescent lamps, while the total connected load in kilowatts was 277,653.

The combined results of operations of the corporation and subsidiary companies for 1915 were as follows:

Operating revenue of subsidiary companies		$37,471,228
Operating expenses, including amortization charges and taxes		22,094,678
Operating income		$15,376,550
Non-operating income		419,073
Balance		$15,795,623
Income deductions of subsidiary companies (bond interest, rentals and miscellaneous interest charges)		12,209,215
Balance		$3,586,408
Public Service Corporation of New Jersey income from securities pledged (exclusive of dividends on stocks of operating companies) and from miscellaneous sources	$2,437,874	
Less expenses and taxes	86,065	2,351,809
		$5,938,217
Public Service Corporation of New Jersey income deductions:		
Interest charges	$3,474,135	
Amortization of debt discount and expense	248,289	
Sinking fund for Public Service general mortgage 5 per cent bonds	209,500	
Other contractual deductions from income	35,041	3,966,965
Net income		$1,971,252
Appropriation accounts of subsidiary companies:		
Amortization of new business expenditures prior to Jan. 1, 1911	$40,330	
Adjustments of surplus account	3,100	43,430
		$1,927,822
Appropriation accounts of Public Service Corporation of New Jersey (exclusive of dividends)		81,518
Net increase in surplus		$1,846,304

Electrified Divisions of the St. Paul Operating Well Under Difficulties

Since the first of the year the operating difficulties in the Rocky Mountain divisions of the Chicago, Milwaukee & St. Paul Railway have been greatly increased by a combination of causes. The temperature fell as low as 40 deg. below zero at times, the volume of freight traffic doubled in February, snowstorms blocked the line and when high water came, the highest since the line was opened, a main line bridge burned in the midst of flood troubles. The congestion due to operating difficulties began just about the time the electric locomotives were put in regular service, and although the overhead construction was only just completed, and operation of high-voltage equipment was new to all and no special repair shop facilities had been provided for the electric locomotives, they continued in regular service without a hitch. Eleven of them are replacing fifteen steam engines in taking trains over 1.6 per cent and 2 per cent grades.

Of the electric locomotives in regular service not one has been held up in the shops for more than a day at a time on account of repairs or changes. To a representative of the ELECTRICAL WORLD, who visited the

shops at Deer Lodge, Mont., where the handling of electrical equipment has been centralized, it was pointed out that when electric locomotives have entirely replaced all steam engines handled at this point, the reduction in the shop force will be about as follows: boilermakers, 98 per cent; blacksmiths, 60 per cent; machinists, 20 per cent. At present the shop attendants provided especially for the electric locomotives include three crews, each consisting of three electricians and three helpers.

Repairing a Transmission Line in a Storm

How Wireless Helped a Western Company to Locate a Line Break and Provided Satisfactory Means for Communicating Work Orders

Early in February a most unusual sleet storm swept Portland, Ore., and vicinity, the details of which have just come to hand. The condition of the atmosphere was such that a heavy rain falling from an upper stratum of warm air passed through an extremely cold stratum next to the ground, and formed a solid coating of ice over everything exposed to the weather. Overhead construction of all sorts was covered with ice for the greater part of two days. The stresses caused by an ice coating of from 1 in. to 4 in. in diameter which formed on telephone, trolley and power conductors throughout Portland caused considerable damage.

At the height of the storm, which was early in the morning, the 65-mile transmission line of the Northwestern Electric Company extending into Portland went out of commission without warning, and the engineers commenced the task of locating and repairing the break. For an hour after the line failure occurred communication with the generating station was maintained by means of the wireless load-dispatching equipment used by this company and described in the ELECTRICAL WORLD of Jan. 1, 1916. At the end of this time, however, the ice on the guy wires brought down one of the 125-ft. poles supporting the company's aerial in Portland, and prevented further use of this equipment.

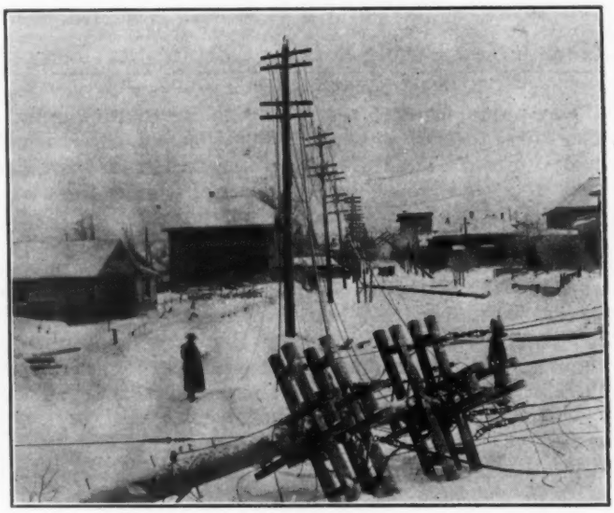
The company at once arranged to transfer its operators to the plant used for instruction in the Y. M. C. A. Wireless School. This plant used a short-wave length, while the company's plants had been tuned for a 1600-m. wave, so for some little time the operators at Portland could plainly hear the calls of the generating station —the Condit plant—without being able to answer. However, the operator at the generating station, upon getting no response to calls, began experimenting with the tuning device, and finally picked up the calls that were being sent out continually from Portland at the lower wave length. Once communication was established on this basis there was no further interruption.

After considerable difficulty the transmission line break was located at the Columbia River crossing, 16 miles from Portland, where three ¾-in. plow steel conductors convey the current over long spans totaling 1.6 miles between the shore ends. Some of the towers are 150 ft. high, and the spans range up to 1200 ft. It was found that one of the insulators on a dead end on each line had broken and all three conductors had gone down, from shore to shore, although no towers or poles were damaged or out of place. The weather conditions were so severe that an expert on snowshoes and skis, using both these means of travel, required twenty-six hours to cover the 16 miles.

A repair crew of twelve men reached the scene of the break by means of an ice-breaking, steel-prowed tug the second night after the line went down. It was then found that the parts of the ¾-in. conductors which were still off the ground were encased in 4½ in. of ice. Where the line rested on the ground it was under 6 in. of solid ice. The men at once set to work with axes to chop the frozen line free. Progress was necessarily slow the first day, and during the night a heavy freeze made it necessary to go over a great deal of the work again on the following morning. By that time a snowplow had been worked through on the railroad, which follows the north shore of the Columbia River, and with it came an additional force of company linemen from Portland.

Even with adequate forces, the high wind, sleet and snow made the repair work extremely difficult, but by working day and night the cables were finally pulled up, temporary dead ends rigged and the conductors put in commission again on the morning of the seventh day after the break. During this time the company's steam generating station in Portland carried the full city load, so there was no interruption to the service.

In the course of the week the wireless plant at the generating station was the only means of communication between Portland and the scene of the repair work. Messages went by wireless to the generating station and thence by the transmission line telephone to Camas substation, which was used as a supply base by the repair crew. Some 290 messages were sent to the plant over the wireless without a single error, although many of these were bills of material on order, some lists containing thirty or more items.



LINES DOWN IN PORTLAND AFTER STORM

Besides company business the operator at the generating station transmitted train orders for the Spokane, Portland & Southern Railroad, whose telegraph lines were intermittently down for several days between White Salmon and Portland. By wireless were also transmitted gratuitously messages by stormbound passengers on the railroad, and even the weather bureau reports from east of the Cascades were relayed on to Portland. So satisfactory was the wireless service that the telephone leads on the transmission line were not repaired until after all the other work had been finished. This efficient service record was not made, however, without almost heroic effort on the part of the operator at the generating station, who stayed by his apparatus with only one-hour rest periods for the greater part of four nights and five days which elapsed before a relief could reach him.

The work of repairing the transmission line was under the direction of L. T. Merwin, operating superintendent of the Northwestern Electric Company, to whom credit is also due for the adaptation of the wireless to central station service.

Bureau of Standards to Hold Conference at Atlanta

At the invitation of the technical committee of the Affiliated Engineering Societies of Atlanta, Ga., the Bureau of Standards will hold a conference in that city May 2 to 4 for the purpose of discussing the work of the Bureau in connection with the national electrical safety code and the prevention of electrolysis of gas and water pipes, cable sheaths, and other metallic underground structures. The conference will be participated in not only by the technical societies of Atlanta under whose auspices it is to be held, but also by city electricians, engineers of public utility corporations, consulting engineers, and others interested, and a large attendance is expected from Georgia and the neighboring states, and other parts of the country.

The conference will occupy three days. The first day will be devoted to the consideration of the national electrical safety code. At this session representatives of the Bureau of Standards will outline the work that has been done on the code and give a statement of the principal features of the code and the main changes that have been made in the course of its last revision, after which a general discussion of the code will be held.

At the second session on May 3 an account of the work of the Bureau of Standards on electrolysis prevention will be presented, including the laboratory researches and field studies and surveys that have been made, and giving a discussion of the proper methods of procedure in making electrolysis investigations and in the mitigation of electrolysis troubles. This paper will also be followed by an open discussion.

At the third session on May 4, the subject of grounding of low-voltage light and power circuits will be discussed. As in the other sessions, the discussion will be preceded by a paper setting forth the essential provisions of the national electrical safety code regarding the grounding of circuits and explaining the advantages of grounding, the methods of grounding, and the reasons which have led to the adoption of the code requirements.

Engineers of water and gas companies, as well as electrical engineers, who are interested in the electrolysis discussions, and superintendents and engineers of water companies have been invited to take part in the discussion of grounding.

The chief purpose of the conference is to bring the cities and the public utility corporations of the South into closer touch with the work of the Bureau of Standards in connection with public utility problems. All persons interested in the safe construction and operation of electrical lines and equipment and in the mitigation of electrolysis of underground pipe and cable systems will be admitted to the conference.

Dallas Votes on Indeterminate Franchises for Utilities

The voters of Dallas at the election in that city on April 4 adopted all the propositions submitted to them relating to the lighting and traction problems. These are as follows: (1) Authorizing the city to negotiate indeterminate franchises; permitting franchises either upon a 4 per cent gross production tax basis or for service at cost, and authorizing the city to buy the properties after ten years or require their sale to another licensee. (2) Permitting the consolidation of all the street railway systems in Dallas. (3) Approval of model service-at-cost franchise, which city will negotiate with street railway company. (4) Approval of service-at-cost franchise for electric lighting company. (5) Issuance of $500,000 of bonds for a municipal lighting plant.

The service-at-cost franchises are based on the report of E. W. Bemis and require service at cost, plus 7 per cent profits, based on valuation figures contained in the report submitted by Mr. Bemis. These are: Valuation, $4,790,124 with $48,000 additional as working capital and $150,000 for interest charges. Stone & Webster officials decline to discuss the situation. They refer to their statements prior to the election. Charles F. Wallace at that time said the company would not accept the model franchises. The general opinion is that litigation will follow.

Flood-Lighting the Kern County Court House at Fresno, Cal., with 2500 Watts

The handsome new Kern County courthouse at Fresno, Cal., has been flood-lighted by five 500-watt projector units, with the effect shown in the accompanying illustration. At present the building is illuminated from only one side, but the intention is to install a second bank of projectors to illuminate the other end of the structure, reducing shadows on the front of the building, and also increasing the intensity of illumination. The projectors as used are mounted approximately 750 ft. from the courthouse, on the top of a three-story building. On clear nights it is often very difficult to discover the source of the light. The building front lighted measures approximately 100 ft. high and 275 ft. in length. The structure is of white stone and, as pointed out by H. M. Crawford, manager of the commercial department of the San Joaquin Light & Power Corporation, is very easy to illuminate, since it will be noted that, owing to the whiteness of the surface lighted, the number of projectors used is remarkably small, compared with other similar flood-lighting installations.

KERN COUNTY COURT HOUSE AT FRESNO, CAL.

Ownership of Water Power

Holding that fundamental questions of constitutional law affecting the sovereign rights of all Western public lands are involved, Attorney-General G. M. Brown of Oregon has submitted to the United States Supreme Court a brief in the case of the United States, appellant, against the Beaver River Power Company of Utah. The brief is filed on behalf of Oregon as a "friend of the court," the same action being taken by other Western States with the hope of assisting to establish State sovereignty relative to natural resources and blocking alleged government interference.

Underwriters Pass Resolutions on Death of C. J. H. Woodbury

The electrical committee of the National Fire Protection Association at a recent meeting held in Boston, Mass., passed resolutions on the death of C. J. H. Woodbury, who for many years was intimately connected with work on the national electrical code. A copy of the resolutions has just been sent us by Secretary Sweetland and reads as follows:

"It is with deep sorrow that the members of the Electrical Committee of the National Fire Protection Association have learned of the passing of Charles Jeptha Hill Woodbury. In justice both to the aims and history of this organization and its predecessor, and to the whole electrical industry, as well as to the memory of the deceased, we desire to make a solemn record of our severe professional and personal loss.

"We desire to acknowledge our indebtedness to the deceased for the great amount of pioneer work which he did in connection with the formulation of requirements for the safe installation of electrical wiring and apparatus, starting in 1881 with the first code of rules, and later co-operating with others in the unification of various electrical wiring rules, also for his long and efficient service as secretary of the National Conference on Standard Electrical Rules, which position he held until this body was disbanded.

"It has been our pleasure to note through the deceased's entire life his wonderful power of concentration on the particular matter before him. This did not make him so permanently and exclusively absorbed in his specialized work as to fail to develop a sincere and loving interest in other branches of human thought and activity than his own. We have known him primarily as an electrical engineer. It has, however, been the rare privilege of some of us, and of many others not connected with our calling, to know him as a lover of art and letters, and, as would be expected of one whose forebears were among the early settlers of this continent, an eager student of American and New England history.

"While many organizations, both at home and abroad, gave him the recognition accorded to distinguished men of science, those who knew him as a man are glad to pay him the tribute of respect and affection due to one who was honorable both in business and private life and as a loyal friend.

"We extend to the members of the family of the deceased our sincerest sympathy and express to them our belief that their immediate grief will be softened and sweetened by the solace of knowing that the deceased has lived well and has made abundant contribution to the advancement of his own profession and thereby to the comfort and security of humanity.

"We recommend that these resolutions be incorporated upon the records of this organization and that a copy be sent to the family of the deceased as our memorial."

Prize-Winning Window Displays of New York Edison Company

Twelve months ago Arthur Williams, general commercial manager of the New York Edison Company, inaugurated a plan of giving prizes as an incentive for new ideas in appropriate window displays for the holidays and other days of special interest during the year. Mr. Williams personally offered a first prize of $10 and a second prize of $5, the winning displays to be decided upon by a committee of seven. The stipulations considered in picking the winning exhibits were their drawing power, economy, adaptability to the showrooms of the company, and the extent to which electricity was used in the displays. As a result of the prize offer window display ideas have been coming in thick and fast, and many of the contests have been very close. Three prizes of the number awarded so far have been won by S. H. Bleeland, Jr., of the contract and inspection department.

College Students to Act as Range Salesmen

A series of eleven lectures has been arranged by M. C. Osborn, sales manager of the Washington Water Power Company of Spokane, Wash., for the purpose of interesting and instructing students of the University of Idaho and of Washington State College in the use and sale of electric appliances, particularly ranges. The first ten lectures will be open to all who are interested, and the eleventh is planned to give definite instructions to the fifteen salesmen which the company expects to employ from among those who apply as a result of the lecture series.

The lectures will be given in the evenings, one each week, until the beginning of the summer vacation in June. The sales force of the power company, under the personal direction of Mr. Osborn, will do all of the lecture work, and provision is being made not only for demonstrations, but for explanation of the construction of appliances as well. One of the lectures will include a mock selling talk and final closure of the sale, which will be enacted completely by salesman and prospective customer, beginning with the knock on the front door and going through all the possible objections and questions which a customer might raise before signing the contract.

The topics of the eleven lectures, most of which will be in two parts, the first presented by Mr. Osborn and the second by an assistant, will be as follows: (1) Organization and object of salesmanship course; art of salesmanship. (2) Theory of rates; the rate. (3) General range demonstration; lecture on range types. (4) Water-heater and water-heating rates; range and water-heater wiring. (5) Demonstration of socket appliances; lecture. (6) Lecture on the steps in a sale; demonstrating a sale of range and water heater to a prospect. (7) Demonstration of GE range; construction and inclosed elements. (8) Demonstration Hughes range and radiant elements. (9) Routime. (10) Question Box. (11) Final instructions to the men selected for employment.

New York Public Service Commission Seeks More Power

Bills to give the Public Service Commission of the First District more power in gas rate and service cases were introduced in the Legislature at Albany, N. Y., Wednesday at the request of the commission. The amendments to the law desired by the commission include prohibition or restriction of review of its decisions by certiorari, power to make a new rate effective at any time, power to order repayment of excessive charges and changing the provision for penalties so that the commission may sue for the recovery of a more reasonable amount than $5,000 a day.

It was explained at the offices of the commission that much importance was placed upon a restriction of a review by certiorari. It was stated that proceedings had become so complicated that it is now almost impossible to reach a final conclusion that will not be reversed by the courts.

Line and Substation Construction to Serve Mines

Practice of the Consolidation Coal Company in Building Transmission Lines and Outdoor Substations Operated in Conjunction with Rotary Converter Stations to Serve Seventeen West Virginia Mines from Central Generating Plant

BY RICHARD PERCY HINES

Electrical Engineer, The Consolidation Coal Company, Fairmont, W. Va.

ON account of the general use of electricity in the various processes incidental to the coal-mining industry, such as the employment of electric motor-driven pumps, haulage and gathering locomotives, coal-cutting and drilling machines, electric hoists, and the like, the generation of electrical energy and its transmission to the various mines where it is utilized has become of great importance in this industry.

The types of generating apparatus used, transmission-line design and construction and the character of the converting equipment, together with the methods employed in its installation, have in general followed the development of these phases of the electrical art. It is not strange, therefore, to note that in the generating plants, transmission lines and substations now being installed to serve mines the latest and most modern equipment is being employed.

In what follows the writer will deal especially with the engineering features of service requirements from a central generating system, a transmission system and outdoor types of substations. The installations referred to will show the practice of the Consolidation Coal Company in the West Virginia mining region.

The main generating plant of this company is located at Hutchinson, W. Va. In this station are installed four 23½-in. by 32-in. horizontal twin tandem Bethlehem Steel Company's natural gas engines, each rated at 1500 b.-hp., and direct connected to a 1280-kva., 2300-volt, three-phase, 60-cycle General Electric Company revolving field alternator. Three 1500-kva., oil-insulated, water-cooled transformers step the current up from 2300 volts to 23,000 volts, at which pressure it is transmitted over the main transmission circuits.

Two separate 23,000-volt transmission lines are taken from the station. One circuit extends south from the plant, while the other takes a northerly direction. These two main circuits are about 24 miles in length. The branch lines taken from these are about 13 miles in length and serve the different substations at the mines. There are connected to these lines nine indoor transformer and rotary-converter substations, three sets of transformers installed indoors, seven outdoor transformer substations, and four outdoor transformer substations combined with indoor rotary-converter substations. The total connected load of all these substations is about 4095 kw., and they furnish power to seventeen different mines.

Each of the transmission lines is a single-circuit construction using chestnut poles, the conductors being No. 6 B & S bare, hard-drawn copper wire, arranged in an equilateral triangle, with a 36-in. spacing. Washington fir crossarms with reinforced wood pins and pin-type insulators are used.

In the outdoor substations the transformers, together with the switching and protective apparatus, are mounted on structural steel towers. These towers are rectangular at the base with the four corner posts formed of angles, to which the footplates are riveted. Two channels, placed horizontally, are attached approximately 10 ft. from the bottom, and to these are bolted the eye-beams for supporting the transformers. The towers are about 20 ft. high, and have channels bolted at the top, these being properly drilled to allow the switches and protective apparatus to be bolted to them. The switches for opening and closing the circuit are of the horn-gap type, while the protective apparatus

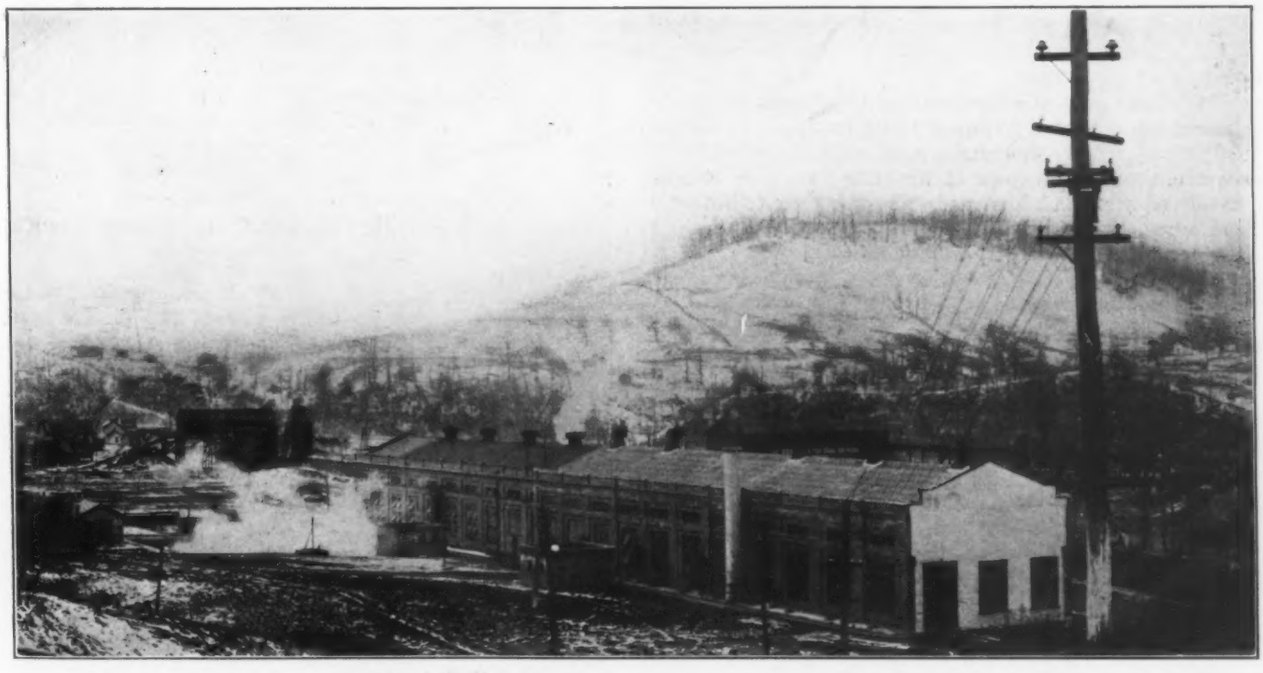


FIG. 1—CENTRAL POWER STATION OF THE CONSOLIDATION COAL COMPANY SHOWING CAR HAULING TRACK IN REAR AND SPRAY POND WITH ENGINE JACKET WATER TREATING PLANT AT THE LEFT

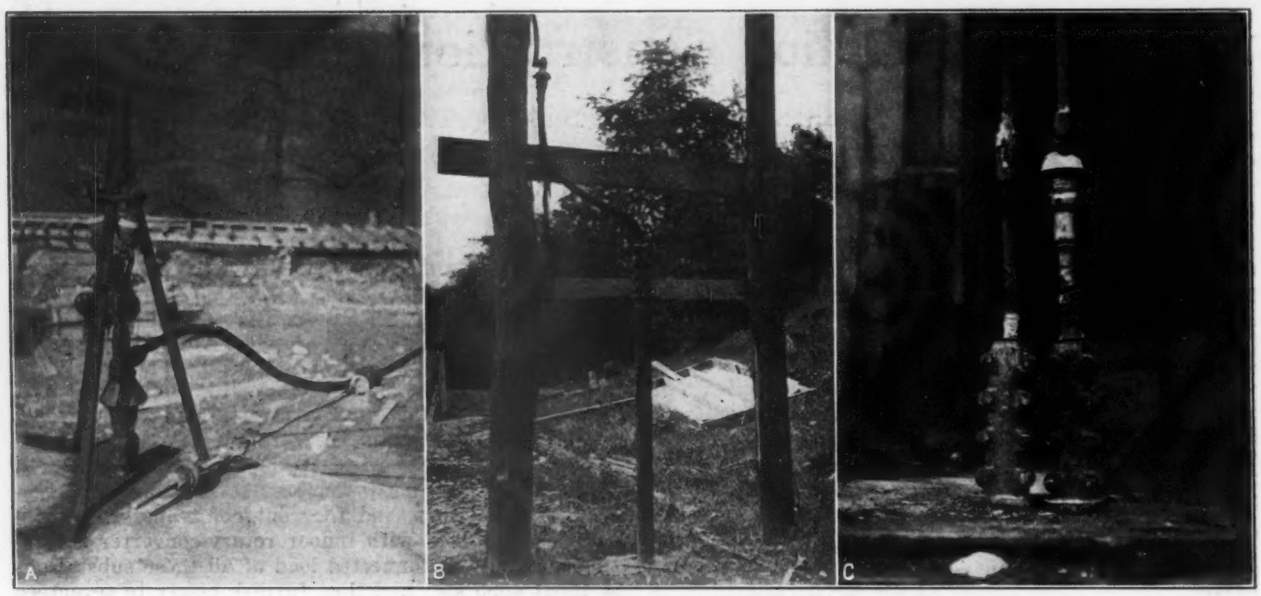


FIG. 2—THREE METHODS OF TAKING DIRECT-CURRENT CABLES INTO MINES

(A) Here a special cable terminal and support is shown installed on the top of a fan wind box. The positive cable seen is bare 800,000 circ. mil single copper conductor suspended vertically in the airshaft 150 ft. deep and held only at the top by this terminal. The cable in the airshaft is insulated with varnished cambric and lead covered. The rails of the mine tracks, thoroughly bonded, are used for return. The negative cable connects to them at the pit mouth. (B) Here the cable leads into the mine through a 5-in. cased bore hole. This cable is 1,500,000 circ. mil copper, single conductor, insulated with varnished cambric, lead covered, wire armored with jute and asphalt over the armor. A special cable terminal and clamp rests on top of the casing. The depth of the bore hole is about 260 ft. (C) In this installation both positive and negative cables are shown suspended vertically in fiber conduit set in concrete sides of an airshaft. The positive cable is on the right. Both are 1,000,000 circ. mil copper. The positive cable is insulated with varnished cambric, lead covered, wire armored and covered with jute and asphalt finish. The negative cable is insulated with varnished cambric and triple weatherproof braid. The depth of the shaft is about 300 ft.

comprises a spade-type choke coil and horn-gap lightning arrester, together with a fused horn gap. The high-tension bus wires are carried on a framework composed of 1¼-in. black iron pipe. This is attached to the members of the tower by means of the standard floor flanges and pipe clamps, now largely used in switchboard work. The porcelain insulators carrying the bus wires have cemented in them malleable-iron pins, arranged for clamping to the 1¼-in. pipe crosspieces. The pin proper is separable from the base and is held rigid. The height of the insulator above the base may be varied within the limits of adjustment by means of a lock nut on the pin, with the pin itself screwed into the base. The busbars are made of No. 0000 B & S bare, soft-drawn copper wire, and in connecting the high-tension transformer leads and the lines from the fused horn gaps to the bus, split terminals, held fast to the bus by a couple of screws, are used. This allows any transformer or the main leads to the bus to be readily disconnected or reconnected.

FIG. 3—THREE 100-KVA., SINGLE-PHASE TRANSFORMERS WITH PROTECTIVE APPARATUS

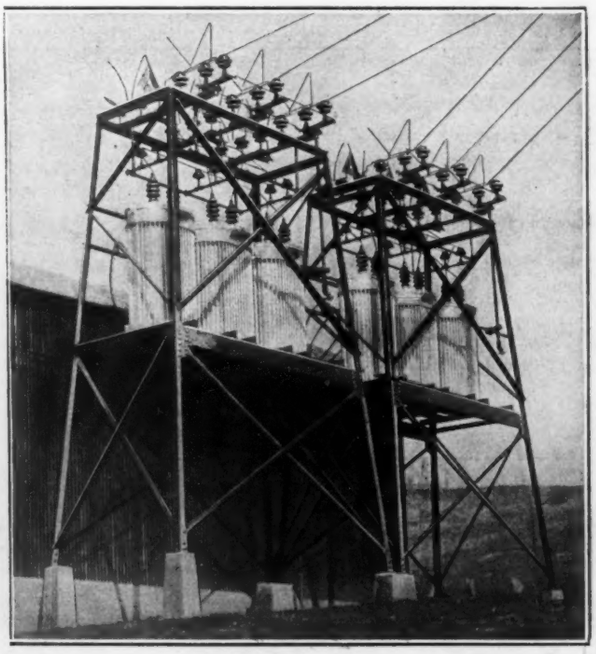


FIG. 4 — A DOUBLE INSTALLATION OF TWO OUTDOOR TRANSFORMER SUBSTATIONS

The installation in Fig. 4 is used in connection with two rotary converters installed indoors at mine No. 40. The substation in Fig. 3 furnished energy at 2200 volts to transformers in a mine converter substation. This installation serves both converters and a 125-hp. motor inside the mine.

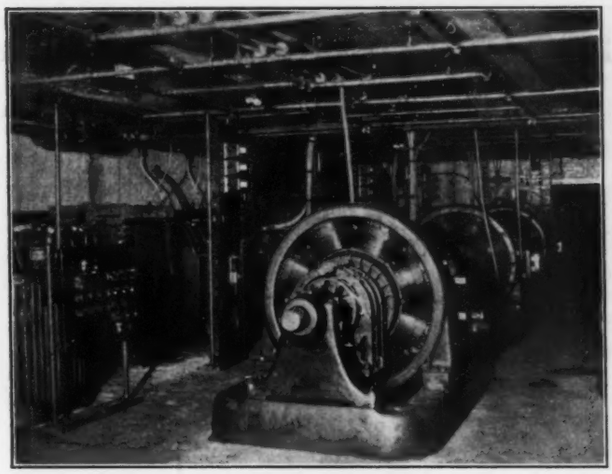


FIG. 5 — SYNCHRONOUS CONVERTER SUBSTATION INSIDE OF MINE

Three 150-kw., six-phase, 60-cycle, synchronous converters are installed in this substation. Conductors are led in the mine through a 275-ft. vertical cased bore hole. Three-conductor cable, insulated with varnished cambric, lead covered and wire armored, is used. All wiring overhead is in 1¼-in. iron pipe.

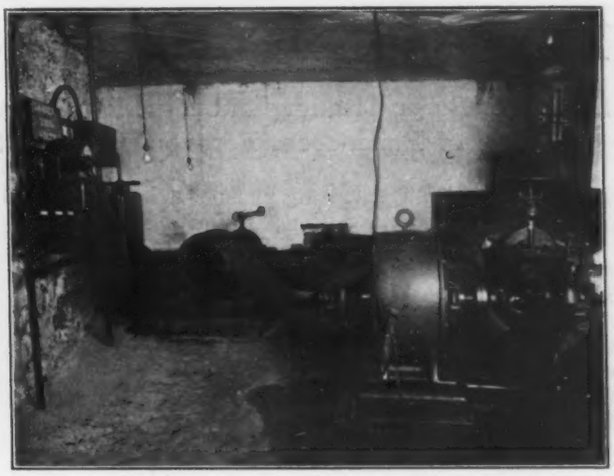


FIG. 6—MOTOR-DRIVEN CENTRIFUGAL PUMPS IN ONE OF THE COMPANY'S MINES

On the left is a 50-hp., 2200-volt, motor-driven unit with its oil switch and starting compensator outfit. On the right is shown a 30-hp., 275-volt, direct-current motor driving a small pump. The leads to both motors are taken through a vertical bore hole in the earth.

The low-tension circuit from the transformers is also connected by detachable connectors and carried on porcelain insulators, supported by pins, fastened to a cross-piece on the tower. The Burke horn-gap switch has its three poles connected together so that they are opened or closed simultaneously. A pipe rod is fastened to the switch and provided at its end with a handle, by means of which the switch may be operated from the level of the transformer platform. A locking device is provided so that the handle of the switch may be held either in the open or the closed position.

Each foot of the steel tower is solidly grounded to a copper plate or pipe ground. The towers are designed to safely support a load of 14,000 lb.

A double installation of two outdoor transformer substations used in connection with two rotary converters installed indoors is shown in Fig. 4. Each transformer is rated as 55 kva., 22,000/175 volts, and is a single-phase, oil-cooled, 60-cycle design. Each bank of three units furnishes energy to a 150-kw., three-phase, 60-cycle, 1200-r.p.m., 275-volt, direct-current, synchronous converter.

In Fig. 3 a substation is shown which consists of three 100-kva., 22,000/2200-volt, single-phase, 60-cycle, oil-cooled transformers and Burke protective apparatus. After being transformed to 2200 volts, the energy is carried into the mine through a bore hole by means of a three-conductor, varnished-cambric-insulated, lead-covered cable. This type of construction is shown in Fig. 2. Inside of the mine there is installed a 150-kw. synchronous converter substation with the necessary set of transformers to transform from 2200 volts to the rotary voltage. There is also in operation a 1000 gal. per minute triplex pump, driven by a 125-hp., 2200-volt, three-phase, 60-cycle, squirrel-cage induction motor.

The outdoor steel towers and their switching equipment illustrated were designed and constructed by the Railway & Industrial Engineering Company, Pittsburgh.

FIG 7—INTERIOR OF GENERATING STATION SHOWING 1500-HP. GAS ENGINES DRIVING 1280-KVA. GENERATORS

Methods for Handling Boilers in 100,000-Kw. Station

Details of Boiler Cleaning and Inspection—Practice in Handling Loads and Scheduling Work of Boiler-room Force at L Street Station of Boston Edison Company

THE principal generating plant of the Edison Electric Illuminating Company of Boston, Mass., known as the L Street Station at South Boston, supplies energy to a territory of more than 700 square miles. The rating of the generating equipment in the station is approximately 100,000 kw., and a large part of eastern Massachusetts is dependent upon this plant for electrical service. Through the courtesy of President Charles L. Edgar of the Edison company and of Prof. D. C. Jackson of the Massachusetts Institute of Technology, the methods of operating the boiler installation in this great station are presented in what follows, based upon a study of the plant by Verne C. Kennedy when completed in 1915 in connection with thesis work in the electrical engineering department of the Institute.

Boiler Plant and Coal Storage of L Street Station

The boiler-room equipment consists of forty-eight Babcock & Wilcox boilers, eight of which are provided with Roney automatic stokers, the remaining forty being equipped with Murphy automatic furnaces. The Roney stokers are electrically driven, the Murphy installation being steam-operated. The plant is located on Boston Harbor. Two steam unloading towers are used to take coal from barges. It is then carried by a belt conveyor to a storage field of 60,000 tons' capacity directly adjacent to the plant. From the field the fuel is hoisted by two traveling cranes and delivered to bunkers in the boiler house by another belt conveyor.

On the way from the yard the coal passes over automatic scales registering the amount that is used and then into a crusher. Samples for analysis are taken just before the coal is crushed. In this way the coal which is purchased on a specification basis is accurately checked up. The coal is fed from the bunkers directly into the furnaces by chutes arranged to permit weighing at each furnace. These scales, however, are not used except in boiler tests.

The engineer in charge of the boiler room is expected to maintain the highest efficiency possible with an economical expenditure of time and labor. The actual operation of the equipment requires the services of three foremen, three repairmen, three tube blowers, seven water tenders, seven coal passers, and twenty-seven firemen. These men work on three eight-hour shifts, beginning at 11 p. m., 7 a. m. and 3 p. m. All important repair work and the inspection work is performed during the day watch under the personal supervision of the engineer in charge, the other watches being under the direction of foremen whose duties are chiefly to see that orders left by the engineer are carried out, that the fires are properly maintained, the banked boilers properly cared for, and in general to watch operation. These men have sufficient responsibility to cope with emergencies until the assistant chief engineer of the station can be notified.

Feed-Water Treatment

Treatment of feed water for scale prevention is accomplished by the installation of a small cylinder upon the turbine pump so that a small amount of Dearborn heated compound is introduced at each stroke. It is also

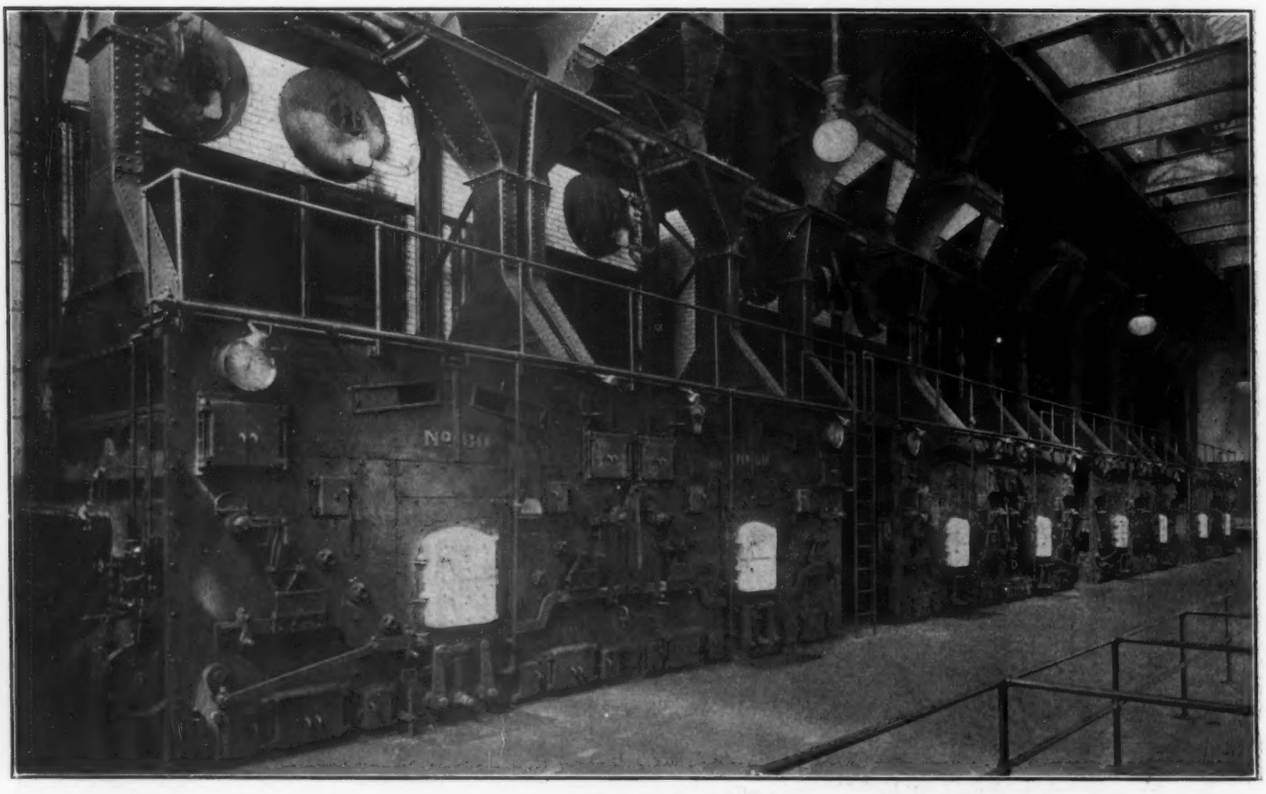


FIG. 1—ROW OF WATER-TUBE BOILERS EQUIPPED WITH AUTOMATIC SIDE-FEED FURNACES IN THE L STREET STATION OF THE BOSTON EDISON COMPANY

necessary, however, to remove scale by washing out the boilers every thirty days.

Frequent inspection of the lower rows of boiler tubes enables the conditions of scale formation to be closely followed. If the scale has a tendency to become excessive the tubes are calipered since a mere observation will not give a sufficiently accurate check of the thickness of scale formation. Out of the entire forty-eight boilers only a few bagged tubes have resulted in several years. Every thirty days the drums are thoroughly washed and the water changed.

BOILER TUBE INSPECTION

A tube inspection is conducted every sixty days. This consists in opening up the lower rows of tubes as high

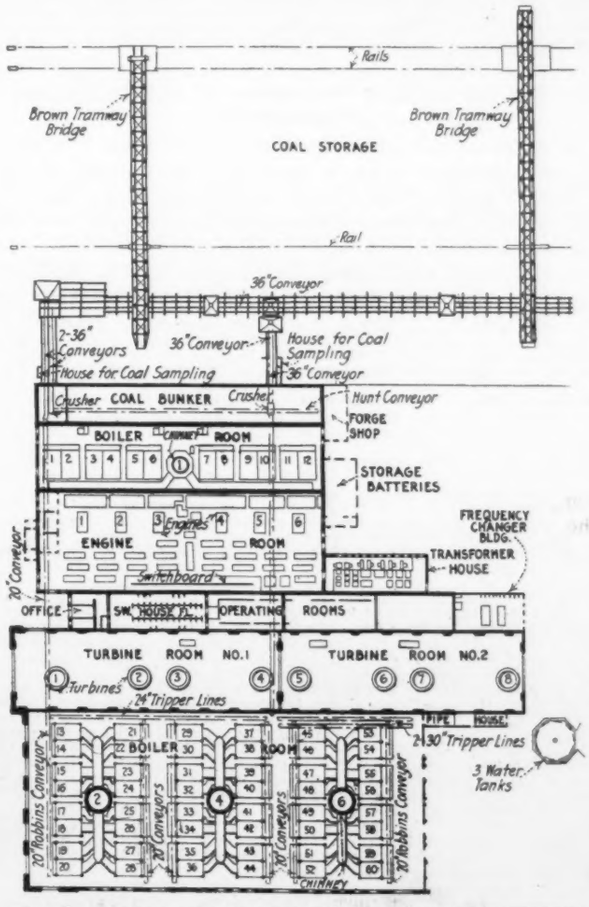


FIG. 2—LAYOUT OF L STREET STATION OF BOSTON EDISON COMPANY

up as the inspector finds scale. The lower row of tubes is generally found to be sufficient. The scale thickness is then estimated or calipered if aggravated. At the L Street Station it is seldom necessary to do more than look into the tubes on account of the thoroughness with which the removal of impurities is carried on.

The boilers annually receive an interior inspection by the insurance company. Before this inspection occurs the boilers are opened up and entirely overhauled by the engineer in charge of the boiler room. It is seldom that the insurance inspectors find any fault with the condition of the boilers. In preparing for an inspection, connections are cleaned, tubes blown, front and back headers are blown and mud drum nipples are cleaned. The boiler is then tested by hydraulic pressure, so that any leaks may be repaired while the boiler is down. Red tags are placed on the valves to show that none is to be touched, all valves leading to and from the boiler being tagged. Scale is chipped off any head-

FIG. 3—SECTION OF 60,000-TON COAL FIELD AT L STREET STATION

ers that may not have been removed in blowing. The bottom rows of caps, front and back, and mud drum caps are removed. Rear manhole plates, and if necessary those in front, are removed. Besides removing the caps on the lower rows of tubes, one cap is removed on each row all the way up on the front and about half-way up on the back, but if necessary the removal is continued to the top in the back as well as in the front. A cap is also removed on each superheater header.

CLEANING OF TUBES AND SETTINGS

The cleaning of tubes and settings in this station is handled in the following manner. The evening before cleaning, the engineer makes out a list of the men who are to take part in the work. After each man's name is listed the partner with whom he is to work, the tools he is to use, the boilers to be worked on and the order of their cleaning. The required tools are assigned to the men at the station tool-room and are numbered to correspond with the numbers on the assignment sheet. If any questions are necessary, so far as possible, they are asked the night before. Thus when the men come to the plant in the morning they go directly to work without loss of time. If accidents happen to any of the tools or if the lamps become broken, they are checked off against the party using that particular set of tools.

The cleaning of furnaces usually requires three sets of cleaners, two working together, and two sets of tube

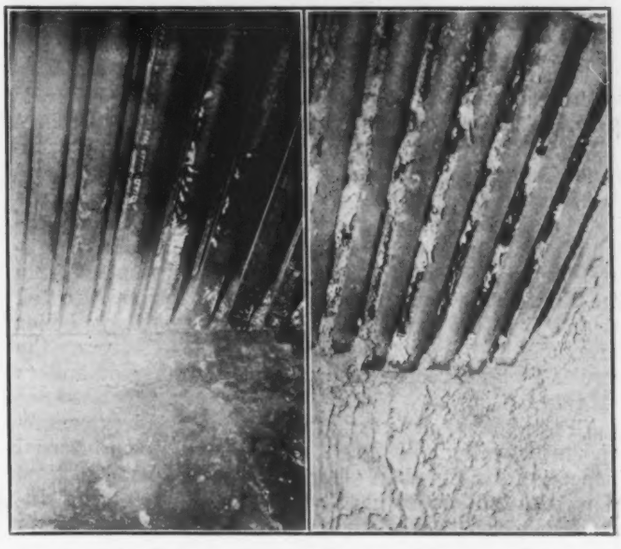


FIG. 4—APPEARANCE OF TUBES AND BRIDGE WALL AFTER CLEANING COMPARED WITH BEFORE

blowers, also working in pairs. The men who clean the furnaces clean off the grates and bridge walls, and see that the passages are in such shape that the coal will feed down properly, leaving the entire interior of the furnace in first-class condition as far as dirt goes. The bridge walls are usually covered with a hard clinker which requires the use of a pick in dislodging it. Care is taken not to tear the wall in removing this material. If it is not thickly covered, it may be best to let it go until more accumulates, as the tendency is for the wall to wear away very quickly at best. A small amount of clinker is left in the V of the grates so that the new coal will not fall through between the grates when the fire is built up again.

The men blowing tubes are sent into the connections and by means of a jet of steam and long hooks remove all the clinkers and soot from the tubes.

It is not sufficient merely to clean the tubes with steam when the boilers are off the line, for the passages between the tubes soon become blocked and must be opened again if the boilers are to be operated efficiently. It is therefore necessary to blow these tubes while the boilers are in operation. This is done by a steam nozzle. When the boiler is off the line a thorough job is done, but when it is in service the pipe and nozzle are merely shoved through holes left in the setting and worked from side to side, taking care that the steam jet does not play directly upon the tube surfaces. Even

FIG. 5—GRAPHIC RECORD SHOWING FURNACE AND BOILER PERFORMANCE

with a system of tube blowing where each boiler is blown off every other day the soot and clinker collect after at least two weeks to such an extent that the passage of gases is materially impeded.

After the boilers are cleaned the engineer goes into them and makes a minute inspection of all defects, examining any particular features which, in case of failure, would necessitate the removal of the boiler from the line. This inspection enables the engineer to tell at any time the exact working condition of any bolier on or off the line and to predict with close accuracy the results to be expected from a given number of boilers on duty.

All the boilers are very carefully inspected externally without warning at frequent intervals, while an internal inspection is carried on after the company has had time to put the boilers in good condition. The external inspection gives a check upon the plant operation from day to day and the latter insures a thorough yearly overhauling. Particular attention is always given to

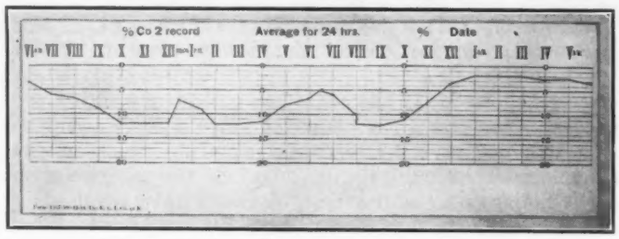


FIG. 6—VARIATION IN CO_2 DURING A TWENTY-FOUR-HOUR PERIOD

the tubes, so that any which have become bagged or otherwise defective can be removed promptly. Records of both the monthly and the yearly inspections are kept and used to check up the condition of the boilers from time to time. These are valuable in comparative studies of operating economy.

INSPECTION RULES FOLLOWED IN BOSTON EDISON BOILER ROOM

External

Look for bagged tubes. Examine the condition of grates and brickwork as well as the front of the first pass flame sheet, particularly the bricks on the top courses of the bridge wall. If there is any leak there inefficient operation results, and also, jets of flame will burn away the angle-beam or angle-iron on top of the bridge wall.

Note any leaks at the expanded joints of the steam drum nipples, tubes, cross-box and drum seams, expanded joints of superheater tubes, and the pad at the bottom of the drum where the dry pipe enters. Also examine the rivet heads at the latter point. Make sure that the fusible plug is not melted and that it does not project too far into the nut. See that the superheater hangers are in good condition as well as the baffle walls under the superheater and the rest of the brickwork in the first pass.

In the top of the second pass examine the rivets and drum seams as before. Also examine the expanded joints of the circulating nipples, the rear of the tubes and the dry-pipe pad at the bottom of the drums. Examine the ends of the superheater tubes and note if the flared end is worn away. Note the condition of the superheater bends and the nipples between the headers (if boiler is of the double superheater type). Examine around the caps and determine if there have been any leaks, especially those provided for expanding the 5-in. superheater bends at the bottom of the longest header, which may have started corrosion in the headers. Examine the brickwork in this pass and while here look at the damper and see that it does not foul anywhere in its travel from the open to the closed position. The rear cross-box and girth seams should also be examined for leaks.

In the middle connection note the condition of the flame plates and see that the diagonal backing bars are not displaced, especially at the top, as they are only held by clamps around the tubes, which often slip down the incline of the tubes. They seldom become displaced at the bottom, having a more secure fastening. Examine the expanded ends of the tubes and both sides of the second flame plates. Sound the front side of the mud-drum nipples. Note the condition of the brickwork and see that the front side of the wall under the mud drum is all right. See that the doors on the wall open and close easily. In the third pass sound the rear of the mud-drum nipples and the blow-off pipe. Look into the tube ends and mud drum for scale and note the condition of the ends of the tubes. Sound the nuts securing the flanged L's to the bottom of the mud drums and note any leaks at both ends of the blow-off pipe, both inside and outside the boiler. Examine the rear of the mud-drum wall and the brickwork. Look inside the tubes at the front of the boiler for scale and note the condition of the tube ends. Go on top of the boiler and sound the nuts that support the steam drums.

Internal Inspection

Sound the manhole plates and studs. Sound both front and back heads and look for cracks or grooving on the flange of the head as well as the flange of the manhole. See if the water column connections are clean. Note that the baffle plate over the steam drum nipples does not rest on the rivets or drum sheet (as vibration due to the circulating water will wear them away). Look down the steam drum nipples and note scale conditions. Look for pitting, especially along the water level and along the front side of the circulating baffle plate at the bottom of the drum. Pitting is apt to occur at this latter place, since here the water is generally in less rapid motion than elsewhere in the boiler. Look for grooving along the butt joints and see that the internal feed pipes are securely fastened and not loose in the threads. Sound the rivets throughout the boiler and see that the fusible plug projects in at least 1 in. This last precaution is necessary, since it is prescribed by Massachusetts law. Examine the dry pipe and see that it is not only securely fastened but that the perforations are at the top. Look down the circulating nipples for scale and see that the Holly system opening as well as all other openings are free from scale. It is advisable to sound the tubes where possible as there is a tendency for them to appear all right and still be laminated.

USE OF STEAM FLOW METERS AND RECORDERS

Steam flow meters are utilized at the L Street Station and are considered accurate enough for comparing the work of the different firemen, but are not sufficiently accurate to give dependable results of the amount of water evaporated from the boilers. If a hole

is allowed to occur in the fuel bed or if the fire is badly kept, the man in charge of the firing aisle is able to ascertain which boiler is responsible for the lag in the steam without the more laborious method of examining the fires through the inspection or firedoors. This results in a more stable condition of the fires and a saving of time and fuel. Bailey recorders are also used to check up the operation of the furnace. These meters show the rate of steam flow from the boiler, the rate of air flow through the furnaces, and the thickness of the fuel bed. These meters give results sufficiently dependable for tests. A carbon-dioxide recorder is attached to one of the flues.

The more minor details of inspection are cared for by the coal passers. Troubles beyond their power to repair is reported to the water tender in charge of the aisle. The water tenders are held responsible for all furnace conditions and report to the foremen and to the engineer. However, all the responsibility of the furnace exteriors is not borne by the water tenders, for the foremen are constantly on the outlook for defects and occasionally go over the piping. All repairs are conducted under the personal supervision of the engineer in charge and no repair job is called complete without his approval. No watch is allowed to leave the floor unless there are 200 lb. of steam, the relief watch being satisfied with the conditions. Injectors are tried three times a week during the noon hour.

HANDLING OF PEAK LOADS

It is the practice of the Edison company to raise the boiler rating at the time of the peak, avoiding substantial banking losses in this way. It is considered unwise, however, to carry more than 2000 kw. per boiler even for a short time, as the efficiency of the boilers and furnaces drops rapidly at this point. Since the increase in output obtained by the use of forced draft is insufficient to carry the load, it is necessary to resort in part to the use of banked boilers. With the Murphy furnace, which is classed with the overfed type of stoker, the operation is chiefly with natural draft. When it is desired to greatly increase the output of the boilers forced draft must be utilized. This is only resorted to in order to carry the peak without excessive banking, the loss due to forced draft being less in this case than that due to keeping the boilers banked.

INSTRUMENT EQUIPMENT OF L STREET BOILER PLANT, BOSTON EDISON COMPANY

Instrument	Number Used	Make
Steam flow meters	36	General Electric Company, Schenectady, N. Y.
Injectors	32	Schutte & Koerting Company, Philadelphia, Pa.
Draft gages (differential)	40	Lewis M. Ellison, Chicago, Ill.
Furnace indicators	2	Bailey Meter Company, Boston, Mass.
CO_2 recorder	1	Sarco Engineering Company, New York City.
Coal scales	2	Howe Scale Company, New York City.
Load indicator (illuminated)	1	National Electric Sign Company, Jersey City, N. J.

A branch of the department of standardization and tests is maintained at L Street for routine testing. Both the steam and electrical departments are served by this staff and frequent tests are carried on to ascertain if the units are operating at the proper points and under the proper conditions to give maximum efficiency.

Lubrication of Station and Industrial Machinery—I

Practical Considerations in Securing Satisfactory Lubrication and Analysis of Operating Requirements of Different Bearing Surfaces with Characteristics of Common Lubricants and Their Application to Follow

BY DR. ARTHUR CURTIS SCOTT
Consulting Engineer, Dallas, Tex.

THE design of prime movers, hydraulic turbines, steam engines and turbines, and internal combustion engines, has received the attention of the world's best engineers in recent years, and the efficiency of these machines has been continually increased in rendering available the energy derived from natural sources to drive industrial machinery. The lubrication of industrial machinery, however, and in certain cases, the lubrication of the prime movers themselves, does not appear to have received comparable attention, nor in fact the attention which it deserves as an important factor in the operating and maintenance costs of industrial establishments.

A great deal of very valuable experimental work on the problems of lubrication has been done by such men as Thurston, Tower, Reynolds, Deeley, Goodman and others, but their work does not appear to have reached the significance with the builders and operators of machinery that it merits and which would undoubtedly, if given proper consideration, serve to reduce waste of power due to improper lubrication to an extent apparently quite unappreciated by many at the present time.

The manufacturers of lubricants can and should assist in reducing the present enormous waste of power due to machinery frictional resistance, and in prolonging the life of prime movers especially, by co-operating closely with builders and operators, and by producing and offering a lubricant of the proper character to fit the conditions under which it is to be used.

Lubrication is an old subject, and while its theory ought to be better understood than it is generally, it is not the purpose of this article to discuss such theory. A number of good books on the subject leave little to be desired in this regard. It is intended in what follows therefore to consider primarily some points of interest pertaining to bearing surface lubrication, the characteristics of common lubricants, and their general application.

In considering the almost unlimited variations of lines of industrial activity, we can trace in any one of them the common use of mechanical energy through a greater or lesser number of transfers and transformations back to some form of prime mover, which transforms potential energy of natural products into kinetic energy. So, whether the prime mover be a waterwheel, a steam engine, a steam turbine, a gas engine, or an oil engine, the object of its operation is the same—to develop power to do work. The transference of this power from the prime mover to some particular mechanism for its direct productive utilization is the first consideration. The second consideration follows that the transfer should be made with as little energy loss as possible. The latter feature has always necessitated the use of lubricants, to reduce friction losses, and

prevent abrasion and deterioration, of relatively moving surfaces, that are frequently pressed closely together, and caused to move over each other at a greater or lesser velocity.

It is only in recent years that the actual losses in the transference of mechanical power have become appreciated and investigated, with a view of reducing them to the lowest practical amount at a minimum of expense.

The general tendency toward the utilization of higher speeds in operating machinery, in order to increase the output and decrease the weight and bulk of same, has necessitated great variations in the material composition and the construction of bearing surfaces, as well as corresponding changes in physical and chemical characteristics of proper lubricants to be used thereon. In so far as common practice is concerned in the operation of industrial machinery, at the present time, however, it appears to the writer that many manufacturers of such machinery, and the manufacturers of lubricants, have not co-operated to a reasonable extent, in reducing the operator's friction losses to the minimum.

Examples have come within the observation of the writer, to indicate clearly that it is of little value to the operator of a large prime mover to have an oil salesman offer him a barrel of lubricating oil on trial, with the understanding that if the oil does not properly lubricate the machine it need not be paid for; the salesman might be acting with the best of motives, but if he fails to understand the requirements of the oil to be used the prime mover may suffer severely, and cause the owner an expense out of all proportion to the value of a barrel of oil. Again, if the builder of the machine does not state the requirements of lubricating oil to be used on his machine, in terms of physical and chemical characteristics which it should possess, the average purchaser has no way of determining the quality to be used. He might require an analysis, but too often is likely to accept the opinion of an oil salesman as to the relative merits of different "brands," rather than incur the expense and trouble of an analysis, which he would be unable to interpret after he secures it because he has no definite standard for comparison.

It is, therefore, intended herein to discuss briefly the general types of bearing surfaces to be lubricated, without entering into details as to materials of construction, and the characteristics of available and possible lubricants for the same, with suggestions concerning the application of lubricants, to the end that such discussion may possibly aid somewhat in improving the existing relations among machine builders, lubricant manufacturers and operators of machinery, to the economic advantage of all.

Classes of Lubrication for Bearing Surfaces

Sliding contact bearing surfaces of all types, whether cylindrical, as the common shaft journal; plane, as the engine slide-valve and piston; or a combination of the two, as the ink rolls of a printing press, are subjected to conditions of operation which necessarily place them in one or more of the following classes with respect to lubrication:

1. Static lubrication.
2. Low-speed lubrication.
3. High-speed lubrication.
4. High-temperature lubrication.
5. Low-temperature lubrication.

A further classification of bearing surfaces which may be made, where the load acts at right angles to the axis, as in common journals, or parallel to the axis, as in thrust and step bearings, does not affect the above classification with respect to lubrication, since all should be lubricated economically to meet the conditions of speed and temperature.

Static Lubrication

If any two solid bearing surfaces were perfectly smooth, they would, when pressed together with a viscous lubricating liquid between them, require but a small force to cause relative motion, but bearing surfaces are seldom perfect and there is actually a greater or lesser interlocking of projecting particles, even through the intervening lubricant. These surface irregularities are readily observable under the microscope, for bearing surfaces which are considered to be quite perfect to the touch, and due largely to the variation in such bearing surface irregularities, with different metal compositions, and workmanship thereon, has resulted in much experimentation, speculation and difference of opinion concerning the coefficient of friction, or the ratio of the frictional resistance to motion, to the weight which presses the bearing surfaces together. Expressed as a formula, we have

$$\mu = \frac{F}{W},$$

where μ is the coefficient of friction; F the frictional resistance; and W the weight upon the surfaces.

Usually the force F to maintain a body in motion differs from that required to start it when at rest. Hence we have two values of the coefficient of friction, which may be designated as μ_1, the static coefficient, and μ, the kinetic coefficient; the latter being of chief importance in operating machinery.

An understanding of the static coefficient of friction for well lubricated surfaces is still incomplete. Tests made by Thurston with sperm oil and lard oil, respectively, show that the value of μ_1 does not increase uniformly with pressure, and further, that lard oil, having about twice the viscosity of sperm oil, gave a much lower value of μ_1, although in a general way it acted similarly to the sperm oil.

In the case of greases and solids acting as lubricants, the lubricating film cannot be wholly expelled by pressure, and, therefore, under ordinary loads in practice the static coefficient is less than that given by viscous oils as lubricants, and undoubtedly the value of μ when the speed is low, decreases with decreasing speed, until the value of μ_1 is reached.

Low Speed Lubrication

At average running speeds and temperatures of bearings of machinery, the friction is almost wholly dependent upon the efficiency of the lubricant, and but slightly upon the materials of the surfaces in contact. With low speeds and heavy loads this is not the case, and such injury may occur at starting as to prevent proper lubrication when running at speed, and consequent overheating of the bearings. The frictional resistance of large pumping engines at starting is frequently evidenced by groans and jerks of the machine, due to the heavy load on the bearings, but the groans and jerks disappear as the speed of 10 ft. to 20 ft. per minute is reached, which causes the bearing surfaces to become separated by a film of the lubricant.

That lubrication, except for light loads, is imperfect at low speeds has been clearly shown by Goodman's tests,* where at 75 lb. pressure per square inch the friction is a minimum at a speed between 5 ft. and 10 ft. per minute, while at 150 lb. pressure per square inch, a speed of 40 ft. per minute is necessary to reduce the frictional resistance to a minimum.

For low speeds and heavy loads, where it is difficult

*Friction and Lubrication of Cylindrical Journals, Goodman (Pamphlet), 1890. Also Lubrication and Lubricants, Archbutt and Deeley (Book), 1907, page 61.

for a complete film of the lubricant to separate the bearing surfaces, the viscosity of the lubricant should be relatively high, and economically takes the form of heavy oils, or better, greases, which consist of oils and fats compounded with enough soap to make a semi-solid mass at ordinary temperature. Where the bearing load is exceptionally heavy, solid lubricants may often be used economically in the form of pure graphite, soapstone, or mica. Graphite appears to produce best results on cast iron surfaces which are naturally somewhat porous.

Greases composed of mineral oil and vegetable fats, or mineral oils emulsified with soap, free from acid, are most satisfactory and economical lubricants for slowly moving shafts and journals, carrying considerable loads under moderate conditions of temperature. The greases, however, should contain no useless adulterant, like clay, and should melt as a whole, rather than have the oil separate out of the compound and leave the soap. Improperly compounded greases frequently behave in this manner, and are of little value as lubricants.

For moderate speeds of shafting, in the vicinity of 100 ft. per minute to 300 ft. per minute, where the loads are moderate (up to 200 lb. per square inch), the principal factors in economical lubrication are viscosity of the lubricant and efficient lubricating devices. In general, the lower the speed, the higher should be the viscosity of the lubricant.

In all cases, it should here be emphasized, the economy in the lubrication of any bearing surface depends, not only upon the speed, load, temperature and character of lubricant, but also upon the design of the bearing surface for efficient distribution of the lubricant, and the type of lubricating device employed.

For example, consider the crank bearings of a moderate speed triplex pump. The bearings may be well designed, the lubricant efficient, but if sight-feed oil cups are used as lubricating devices, as is frequently done, more of the lubricant may be wasted by the oiler in trying to fill the cups while in motion than the machine should reasonably require for thorough lubrication. Compression grease cups, with a good grade of grease used therein, would be just as servicable, and far more economical.

Not infrequently the need of proper lubricating devices, demands that some expensive "fixed" oil, so called because it is not volatile without decomposition, and of which more will be said later on, or, perhaps, a compound of fixed and mineral oils, be used to effect proper lubrication, when a cheaper pure mineral oil would otherwise meet the requirements.

High Speed Lubrication

The thickness of the lubricating film upon bearing surfaces generally increases with the speed, in accordance with the factors of load; area and shape of surfaces, and viscosity of the lubricant.

It has been clearly shown by experimental tests that when plane parallel surfaces are pressed together, and caused to slide over each other with a viscous liquid between, the velocity of the liquid in any intervening plane is proportional to its distance from the stationary surface. The path of flow is more or less distorted, because the lubricant on the stationary surface is at rest. When the velocity with which the moving surface moves is low, the volume of lubricant expelled is the same as that entering, but as the speed increases, the volume entering may slightly exceed that expelled, the excess remaining unaltered, however great the speed.

With plane bearing surfaces in close contact with each other, and of considerable area, the viscosity of the lubricant is of much significance in producing excess accumulation, which forces the surfaces apart until equilibrium of pressures is established. The power of the liquid to enter, however, is practically proportional to its density, and the square root of the velocity, the effect of viscosity being practically neutralized on the moving and stationary surfaces.

Mathematical and experimental evidence shows that the coefficient of friction for plane bearing surfaces, having the lubricating film complete, is affected much more by the velocity with which they move and the load which they carry than by the area of the bearing surfaces, the value of μ being proportional to the square root of the speed (above about 100 ft. per minute), the square root of the load, and the fourth root of the area.

For rotating cylindrical surfaces, however, the value of μ is practically independent of the load, because owing to the curvature they cannot separate sufficiently to allow the lubricant to escape on all sides as freely as for plane bearing surfaces. Moreover, since the thickening of the film can take place only to a limited extent because of the curved surfaces, the value of μ is nearly proportional to increasing speed from rest up to about 100 ft. per minute, and above that speed, becomes proportional to the square root of the speed.

The loads per square inch commonly carried by high-speed bearings are low, and for the bearings of electric motors, small turbine pumps, fans, mill spindles and the like, under ordinary temperature conditions, pure mineral oil of low viscosity is economically used, with an oiling device which keeps the bearings fully supplied with oil, with little or no waste of the lubricant.

Frequently the most satisfactory and economical lubrication of high-speed bearings, at medium temperature, is affected by the use of a "blend" composed of a mineral oil and a fixed oil, in the proportion of about ten to one, respectively.

High Temperature Lubrication

The foregoing statements with respect to lubrication have assumed that the bearings considered, when in operation and efficiently lubricated, would in general show a rise in temperature of but a few degrees Fahrenheit above the surrounding air in their vicinity. There are, however, common examples of bearing surfaces, connected with prime movers particularly, where the normal operating temperature of the bearing surfaces is from 50 deg. Fahr. to perhaps 350 deg. Fahr. above the operating room temperature. Specifically in this regard, we may note the water-cooled, oil lubricated bearings of a steam turbo-generator in operation, which are normally some 60 deg. Fahr. above the room temperature; the working temperatures of the interiors of air-compressor cylinders, steam engine cylinders, and internal combustion engine cylinders.

The experience of the writer has convinced him that such bearing surfaces belong in a class by themselves, with respect to efficient and economical lubrication for three main reasons, viz.:

1. The characteristics of an efficient lubricant to meet the general requirements are well defined.

2. The design of bearing surfaces, together with the distribution of the lubricant thereon, is highly significant.

3. As prime movers, they are of fundamental importance.

It would not for a moment be presumed that the same lubricant would be suitable for all members of this class, chiefly because each is in a temperature division by itself, and further, because some bearing surfaces are cylindrical, and others are plane.

In another section of this article the types of bearing surface lubricants of recognized value will be discussed and a differentiation of lubricant characteristics made with respect to their value.

Iron Wire for Distribution and Transmission Lines

Present Practice in the Construction and Operation of Iron Wire Lines, Together with Test Data Showing Characteristics and Performance When Used to Serve Small Loads

A STEADY advance of copper prices since November, 1914, has made the cost of transmission and distribution line extensions to small consumers who will use a moderate amount of energy almost prohibitive. The burden of the added expense due to this increase in cost of construction must be borne by the consumers or the public utility company who would serve them at its established rates. In the general advance in prices of all materials used in line construction within the past year, copper has shown an advance of more than 100 per cent since March, 1915. No. 6 T.B.—W.P. copper wire, purchased at the present time costs 28.5 cents a pound. An extension of 500 ft. (1000 ft. of wire), therefore costs the utility $31.80 against $14.53 in March, 1915, when the contract price of copper was 13 cents a pound. At these prices a service of 60 ft. (120 ft. of wire) now costs $3.82 against the former cost of $1.74.

Already a number of operating companies are using iron wire for comparatively short branch lines carrying light loads and operating at voltage varying from 6600 to 66,000, and considerable test data showing performance characteristics of such lines are now available. The use of iron wire for transmission purposes is governed largely by local conditions. However, the studies that have been conducted seem to show that at present prices of copper there is a decided advantage to be derived from the use of iron wire at high-tension voltages in those locations where generating costs are low and the location is not near salt water or the air polluted with discharges from blast furnaces, smelters and the like.

In what follows here the results of operating practice in the construction and operation of iron-wire lines is given, together with studies and tests covering the use of iron wire for both distribution and transmission lines to serve small loads.

Results of Investigation Covering Use of Iron Wire for Short Extensions by United Electric Light & Water Company, Waterbury, Conn.

An investigation of the use of triple-braid, weatherproof, galvanized-iron wire as against triple-braid, weatherproof, copper wire for short extensions and services has been made by the United Electric Light & Water Company of Waterbury, Conn. The details and results of this investigation are outlined by T. B. Morgan, assistant engineer, as follows:

Should No. 4 galvanized, triple-braid, weatherproof iron wire be used at a present price of 8.5 cents a pound instead of copper, the cost would be about $14.70 for a 500-ft. extension, and for a service of 60 ft. (120 ft. of wire) $1.76. This would in a small degree bring this part of the business back to more normal conditions such as that of March, 1915, prior to which most of our rates were made. While this reduction is small in comparison to the added expense incurred by an operating company on account of advanced prices of all commodities since the date above mentioned, it would make it possible to connect small consumers on existing lines, with at least some reasonable expectation of a slight return of interest on the investment, the cost of which was figured prior to advanced prices.

It is manifestly impractical to use iron wire in secondary distribution work where there are long runs or a constant current demand of high amperage on account of the greater resistance of iron over copper and the resultant loss and high inductive reactance, yet it is certainly practical and reasonable to consider the use of electrically suitable iron wire on short secondary runs and for services where conditions are favorable.

The endurance of iron wire when exposed to the elements is sufficiently good so that difficulties from this source may be considered negligible. No. 4 galvanized iron should stand up and meet all weather conditions for at least ten years, and in all probability nearer fifteen or twenty. Iron wire purchased at present is of quite another quality than that put upon the market by the wire manufacturers fifteen or twenty years ago. At that time it was used for long runs, which the company does not consider making. Not only an inferior grade of wire was used but the size was very much smaller, while the distance between poles was greater.

The results of the investigation to ascertain what size of wire could be used for the majority of residential consumers in regard to new services with iron as secured by the United Electric Light & Water Company, indicate that No. 4 wire would satisfy the majority of installations. It is necessary to exercise good judgment in the installation of these services as there are instances where it will be necessary to use copper on account of constant or heavy loads. Any company placing iron wire on its lines should keep a record of its location and inspect it more or less regularly, especially when the utility is in a territory bordering salt water.

The following data were collected to ascertain in some degree the possible maximum, minimum and average demands in the various residential sections. Three points were taken to get a variation of types of consumers. In the accompanying tabulation "A" represents wealthy residences, "B" rural districts, and "C" the average residential consumer. The kilowatt-hour consumption of 297 residential consumers for the month ending between Jan. 1 and 20, 1916 are shown herewith.

Class A
75 consumers, maximum indicated consumption..... 165 kw.-hr.
minimum indicated consumption..... 2 kw.-hr.
average indicated consumption..... 44 kw.-hr.

Class B
82 consumers, maximum indicated consumption..... 52 kw.-hr.
minimum indicated consumption..... 2 kw.-hr.
average indicated consumption.....21.3 kw.-hr.

Class C
140 consumers, maximum indicated consumption..... 189 kw.-hr.
minimum indicated consumption..... 4 kw.-hr.
average indicated consumption.....28.4 kw.-hr.

Considering thirty days per month and presuming the consumer uses his circuits a specific number of hours per day, the consumption would be as follows:

TABLE I—KILOWATT HOURS USED PER HOUR BY CLASSES OF CONSUMERS

Class of Consumer	Hours Service is Used per Day											
	1			2			3			4		
	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
A	5.50	0.06	1.460	2.750	0.030	0.730	1.83	0.030	0.465	1.37	0.015	0.365
B	1.77	0.06	0.710	0.885	0.030	0.350	0.59	0.020	0.240	0.44	0.015	0.180
C	6.30	0.13	0.946	3.650	0.065	0.473	2.10	0.042	0.315	1.57	0.032	0.236

TABLE II—DATA IN TABLE I CONVERTED TO SHOW AMPERES AT 110 VOLTS USED BY CLASSES OF CONSUMERS

Class of Consumer	Hours Service is Used per Day											
	1			2			3			4		
	Max.	Min.	Avg.	Max.	Min.	Avg	Max.	Min.	Avg.	Max.	Min.	Avg.
A	50.0	0.55	13.3	25.00	0.27	6.64	16.6	0.20	4.20	12.50	0.14	3.30
B	16.1	0.55	6.5	8.04	0.27	3.20	5.4	0.20	2.20	4.00	0.14	1.64
C	57.3	1.20	8.6	33.20	0.60	4.30	19.9	0.38	2.86	14.28	0.29	2.15

Allowing constant service for three hours a day for thirty days, 20 kw.-hr. per month equals about 2 amp. per hour, 30 kw.-hr. equals about 3 amp. and 50 kw.-hr. equals about 5 amp.

Further analysis of these figures shows that more than 68 per cent of the consumers used less than 30 kw.-hr. per month, or not more than 3 amp. per hour for three hours each day of the darkest month in the year.

TABLE III—SHOWING THE ENERGY CONSUMED BY CUSTOMERS

Class of Consumer	Under 20 Kw.-Hr.	Between 20 and 30 Kw.-Hr.	Between 30 and 50 Kw.-Hr.	Over 50 Kw.-Hr.
A	16	15	17	27
B	43	25	11	3
C	85	20	33	2
Total	144	60	61	32
Per Cent	48.5	20.1	21	10.8

Considering the data for Table III as representing average conditions, it is only necessary for purposes of estimating to select a size of iron wire which will give good service, not prove too heavy for handling, or too costly, and at the same time have a low resistance, plenty of strength and long endurance when exposed to the elements. No. 4 B. W. gage seems to be the most logical size to use in place of No. 6 copper with a resistance ratio of 3.37 to 1.

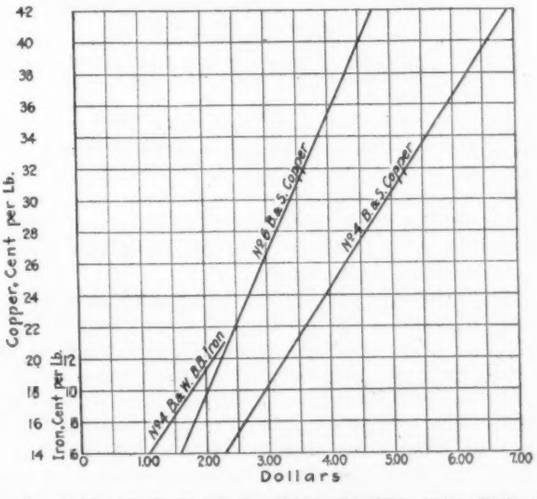


FIG. 1—COST OF T. B.-W. P. SOLID COPPER AND IRON WIRE (SINGLE CONDUCTOR) PER 100 FT.

The data in Table IV compares various sizes of iron and copper wire, upon which this assumption is based. The iron wire considered is B. W. gage and the copper wire B & S gage. The present contract price for copper wire is taken at 24.65 cents and the present market price for copper wire is taken at 28.5. The price for immediate delivery of copper, however, has reached 40 cents.

For a run of single wire for 100 ft. which is carrying 20 amp. for three hours a day, No. 4 iron would show a loss of 2.64 volts or 52.8 watts. This equals 52.8 kw.-hr. per year. No. 6 copper under the same conditions shows a loss of 0.786 volt or 15.72 watts, equalling 17.2 kw.-hr. per year.

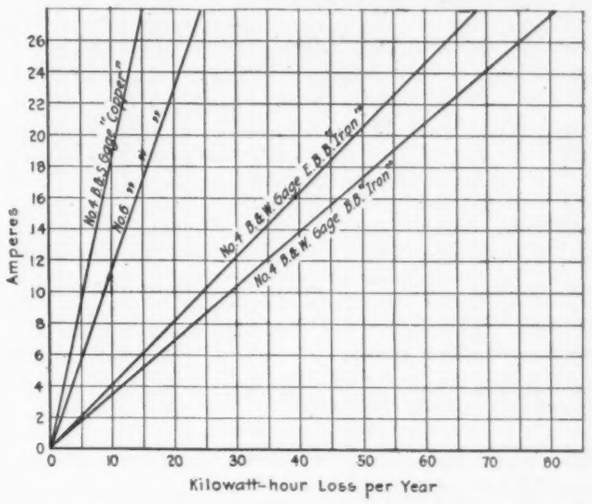


FIG. 2—ANNUAL LOSS FOR 100 FT. SINGLE COPPER AND IRON CONDUCTOR WHEN ENERGY IS USED 3 HR. PER DAY

With No. 4 *(G. T. B.—W. P.) iron wire at 8.25 cents per pound a 100 ft. costs.....$1.470
With No. 6 (G. T. B.—W. P.) copper wire at 15 cents per pound a 100 ft. costs..... 1.676
With No. 6 (G. T. B.—W. P.) copper wire at 24.65 cents. per pound a 100 ft. costs..... 2.750
With No. 6 (G. T. B.—W. P.) copper wire at 28.5 cents per pound a 100 ft. costs..... 3.180
With No. 6 (G. T. B.—W. P.) copper wire at 32 cents per pound a 100 ft. costs..... 3.580

*Galvanized triple-braid weatherproof.

The data gathered from the above-mentioned districts of the United Electric Light & Water Company tend to show the average cost of labor for services to be $1.57 where the maximum cost has been $7.50 and the minimum 34 cents. This includes large services, which brings the average up considerably higher than for an average residential service. Service runs of 15 ft. to 150 ft. of wire show a cost varying from $1.37 to 68

TABLE IV—COST OF SINGLE CONDUCTOR PER MILE

Size of Wire	Price per Pound in Cents	Total Cost
No. 6 copper	15.00	$88.50
No. 4 copper	15.00	129.75
No. 6 copper	24.65	145.43
No. 4 copper	24.65	213.23
No. 6 copper	28.50	168.15
No. 4 copper	28.50	246.52
No. 6 W. P. Iron	8.25	61.05
No. 4 W. P. Iron	8.25	77.55

TABLE V—COMPARATIVE DATA FOR NOS. 4 AND 6 COPPER AND IRON WIRE

Size of Wire	Pounds per Mile		Ohms per Mile		Breaking Weight		Diameter Mils	
	Copper	Iron	Copper	Iron	Copper	Iron	Copper	Iron
No. 6	390	740	2.075	9.60	*1967	....	162.0	203.0
No. 4	865	940	1.308	6.99	....	2361	204.3	238.0
No. 3	....	....	....	....	....	....	229.4	....

*Hard drawn. Resistance ratio of No. 4 iron to No. 6 copper is 3.37 to 1.

cents for labor. This seems to indicate an average cost of $1.03 per service for labor, where the run is not greater than 60 ft. or 120 ft. of wire.

From the various data and curves presented the following table has been arranged.

TABLE VI—CONSTRUCTION COSTS FOR AVERAGE SERVICE RUN OF 60 FT. OR 120 FT. OF WIRE

	Iron at 8.25 Cents	Copper at 15 Cents	Copper at 24.65 Cents	Copper at 28.5 Cents	Copper at 32 Cents
Cost of erection (labor)	$1.03	$1.03	$1.03	$1.03	$1.03
Cost of material (wire only)	1.71	2.01	3.30	3.82	4.30
Cost of loss in kw.-hr. at 1 cent (3 amp. three hours per day four years)	.34	.10	.10	.10	.10
Total	$3.08	$3.14	$4.43	$4.95	$5.43
Interest on investment four years at 10 per cent	$1.23	$1.26	$1.77	$1.98	$2.17
Investment at end of four years	4.31	4.40	6.20	6.93	7.60
Should it be desired to replace iron with copper at the end of four years with copper at 15 cents per pound the cost would be as follows:					
Cost of replacement	$3.04	....	....	....	....
Total cost of line at end of four years	7.35	$4.40	$6.20	$6.93	$7.60

Construction of Iron Wire Lines by East Haddam (Conn.) Electric Light Company.

About eighteen months ago the East Haddam (Conn.) Electric Light Company designed and built a 13,000-volt "composite" line about 10.5 miles long between East Hampton and Colchester, Mass. Three miles of this line is three-phase construction and the balance single-phase. On both legs of the latter and in two legs of the former, No. 4 solid Best-Best Roebling iron wire is used. To add to the conductivity of the three-phase section, one leg of No. 4 B & S copper was installed. The iron wire is all double-galvanized and is strung on nineteen poles per mile, located on private right-of-way. No transposition is made. The maximum drop allowed in designing the line was 5 per cent.

The anticipated future load on the line led Mr. L. P. Perry, general manager of the company, to lay out all sags on the copper conductor basis. This increased the mechanical stability of the construction. No difficulty has been experienced in the operation of the line, either from lightning or from sleet, although one sleet storm coated the wires the whole length of the line 1.5 to 1.75 in. in diameter and was followed by low temperature and a gale. Joints are made with copper sleeves and in erecting the wire was rolled out instead of being dragged in order to protect the galvanizing.

The conductor spacing is 40 in., the three-phase section being installed with legs at the corners of an equilateral triangle. Wooden pins are used at the two lower points, a steel pin being installed at the pole top, but without a ground wire. Best-Best iron wire was used because it has adequate strength and is not too stiff to handle readily. The approximate breaking strength is 2271 lb., and the resistance per mile at 68 deg. Fahr. is 6.91 ohms. The wire weighs about 811 lb. per mile. Its cross-section is virtually that of No. 3 B & S copper. Standard porcelain insulators are employed. The factor of safety used in figuring the line was that prescribed by the N. E. L. A. committee on overhead line construction.

When the line was designed, comparative figures were prepared based on copper at 16 cents per pound, bare copper-clad wire (30 per cent copper) at 14.75 cents; bare galvanized BB iron wire at 3.25 cents, showing voltage drop when transmitting 4 amp. 10 miles. Then the cost of wire only per 10 miles of line was (for 20 miles of wire) $480 for the No. 4 Roebling gage iron, with a voltage drop of 5.6 per cent, compared with $2,130 per mile for No. 4 B & S copper, which gave a drop of 0.9 per cent; and $1,830 per mile for No. 4 copper-clad wire, with a 3.6 per cent drop. Solid wire was chosen in preference to stranded because it has less surface exposed to rusting and hence has a longer life than the latter. Solid No. 4 Roebling gage BB double-galvanized iron wire will weather more than 20 years in the territory served by the East Haddam Company, since the telephone companies secure more than 10 years of life from iron wire one-fifth as large and strong.

A study of the sag and clearance conditions showed the 35-ft. pole to cost less per mile than 25-ft. or 30-ft. poles with a clearance of 18 ft. or more. A minimum clearance of 18 ft. above ground was specified, with 22 ft. over paths and roads. With a standard span of 275 ft. the wire was sighted for the following sags and temperatures: 20 deg. Fahr., 90 in.; 40 deg. to 60 deg., 96 in.; 80 deg., 102 in.; 100 deg., 108 in. The 35-ft. pole is set in a hole 5.5 ft. deep, the two lower insulators being 29 ft. from the ground. The average cost of the pole at the hole is $4.50, the cost of gaining, digging and setting being $4 and the cost of arming $1.40. The total cost per pole is $9.90. The actual cost of the line for the iron-wire section was $517 per mile; the cost of the copper and iron-wire section being $590 per mile, including right-of-way, trimming, supervision, etc. The present cost of iron and copper wire is about double the price of eighteen months ago.

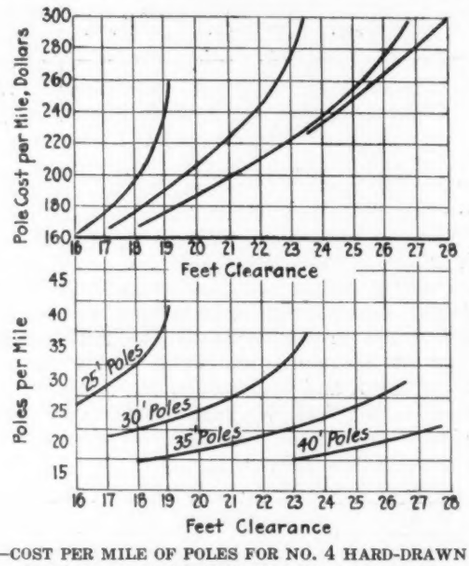


FIG. 3—COST PER MILE OF POLES FOR NO. 4 HARD-DRAWN COPPER LINE WITH DIFFERENT GROUND CLEARANCES

The maximum span on the line is 500 ft., at a point where a stream is crossed. Increased sag was allowed here to afford the usual strength.

A branch three-phase line of No. 4 solid iron wire is now under construction from the main line to North Westchester. On this an aerial ground wire of the same size, material and section as the phase wires is provided. Instead of going to the expense of installing a bayonet arm at the pole top, the pole cutters are instructed to leave 5 ft. of wood beyond the usual 7-in. top at no additional cost. The ground wire is then clamped to the top of the pole. A 4-ft. crossarm is provided, there being a 40-in. horizontal spacing between insulators. A second short arm carries the third-phase wire 4 ft. below at one side, and both arms are braced on the right-hand side. By the use of choke coils at the North Westchester end of the line, combined with the aerial ground, it is expected that no lightning arresters will be required. Both lines are designed to carry copper conductors if future loads demand the change.

Last year the company also operated a 2200-volt

single-phase line 0.5 mile long in serving a summer camp. No. 4 solid iron wire proved satisfactory in this case. It is planned to employ this wire in the near future in 4400-volt rural line extensions, and also to use iron wire in 220-volt secondaries feeding rural lighting customers. It is believed that branch construction will require such iron wire as may be removed later and replaced by copper wire because of increased loading. Iron wire can be removed and replaced by copper wire for a labor cost of about $20 per mile of wire or about 3 cents per pound. It is expected that when future replacements occur, copper wire will be 10 cents or 15 cents per pound less expensive than at present, thereby realizing a net saving by first installing iron wire.

Performance Test for an 8.6 Mile Iron-Wire Line Made by Georgia Railway & Power Company, Atlanta, Ga.

The accompanying curves show the performance of an iron-wire line operated by the Georgia Railway & Power Company between Suwanee and Lawrenceville, Ga. This line is 8.6 miles long, and uses No. 4 B.W.G.-E.B.B. galvanized iron wire with the three conductors

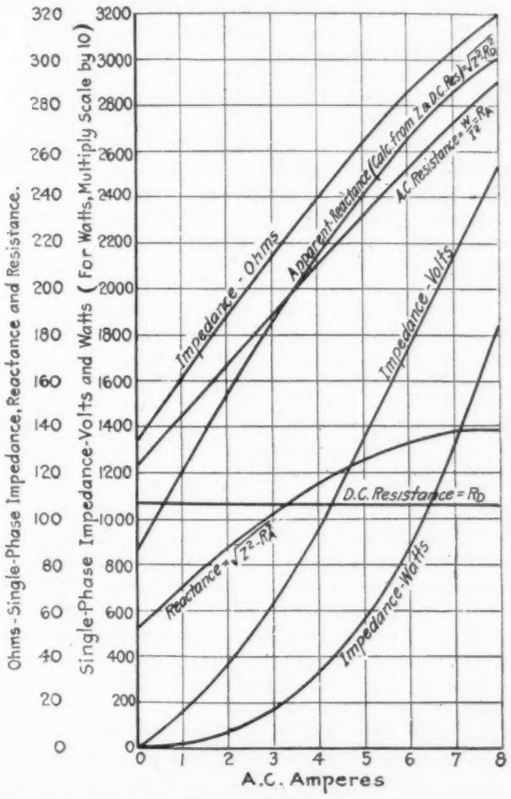

Ohms - Single-Phase Impedance, Reactance and Resistance.
Single-Phase Impedance-Volts and Watts (For Watts, Multiply Scale by 10)
A.C. Amperes
Impedance - Ohms
Apparent Reactance (calc. from 2 a.c. readings)
A.C. Resistance
Impedance - Volts
D.C. Resistance = RD
Reactance
Impedance - Watts

FIG. 4—PERFORMANCE TEST ON 8.6-MILE NO. 4 B. W. G.-E. B. B. 22,000-VOLT IRON-WIRE LINE

supported on crossarms in a horizontal arrangement and spaced 42 in. For conducting the test on this line a 25-kva. transformer having a voltage ratio of 22,000 to 2200-1100-550 was set up at Suwanee to supply current. The high-voltage side of transformer was connected to the main 22,000-volt line. The low-voltage side of the unit was connected to the various phases of the iron-wire line to be tested, which was short-circuited on the transformer frame at the Lawrenceville end. Voltmeter, ammeter and wattmeter readings were taken at 110, 550, 1100 and 2200 volts on single phases, with lines 1 and 2, 2 and 3, and 1 and 3 of the iron-wire line connected. The 110 volts was obtained through a second step-down transformer. Direct-current resistance measurements were taken by means of a Wheatstone bridge. The values shown by the curves are an average of the tests at each voltage.

It is of interest to note that the alternating-current resistance varies with the load, but not as the first power of the load. Two reactances were worked out as shown by the curves. One of the two reactances was calculated from the alternating-current resistance and the impedance. Another reactance curve was worked out from the direct-current resistance and the impedance. For a copper-wire line these two curves should be practically the same, but for the iron-wire line there is a large difference, as shown by the curves, which are labeled to show how they were derived. The power-factor curve, which is not shown, developed points of interest. It showed that the power factor of the line at 0.5 amp. was 91 per cent; at 4 amp. 88 per cent and at 8 amp. 90 per cent. As carefully checked instruments were used and tests were made with due regard to accuracy, it is considered that these values represent actual conditions. These tests were made by J. O. Hardin, engineer of construction, and E. P. Peck, superintendent department of tests and repairs of the Georgia Railway & Power Company.

Operation of an Iron-Wire Line Serving Small Town from Station of Monmouth (Ill.) Public Service Company.

The Monmouth (Ill.) Public Service Company operates a three-phase, 13,200-volt, iron-wire line about twelve miles long to furnish energy to the village of Roseville, Ill., from its Monmouth station. The line is constructed with No. 6 E. B. B. iron wire. The peak load of Roseville, a village of 880 people, is about 30 kw. The regulation of the line is satisfactory without the use of a night feeder regulator.

Use of Iron Wire by Public Service Company of Northern Illinois.

The Public Service Company of Northern Illinois about two years ago began to experiment in its Waukegan district with the use of iron wire on the "fag" ends of lines carrying light loads. About forty customers are now receiving service over iron wire lines built of No. 8 wire strung on 25-ft. or 30-ft. poles.

The principal place in which the use of iron wire has been found advantageous is on the premises of a customer, who, owing to the fact that his residence is an isolated one, standing several hundred feet from the highway, must himself pay for the line extension. Here the substitution of No. 8 iron wire primaries has relieved the customer of a large portion of the expense called for by using copper, and does not interfere with the quality of service since his load as a rule will not exceed 1 kw. From the point where the 2300-volt primary lines end in a step-down transformer to the customer's house, a copper wire drop is strung as in ordinary practice. Besides using this type of construction on customers' premises, the company has lately been trying it on lines along highways.

The company's engineers realize that a possible weakness in this type of construction may develop at the junctions of the copper wires and the iron wires, due to local electrolytic action between the two dissimilar metals. As a rule, however, these joints are not under line tension, and they are always protected from water by the liberal use of friction tape. To date no trouble from this source has developed.

Alternating Current Resistance of Iron-Wire Lines Operated by Texas Power & Light Company.

The curve in Fig. 5 shows the effective resistance of 9/32-in. seven-strand steel cable when carrying various 60-cycle currents as derived from tests on two three-

phase lines operated by the Texas Power & Light Company. One of these lines is 7.32 miles long and the other 6.85 miles long. The greater part of both lines has three conductors arranged in a horizontal plane with an effective spacing of 5 ft. The values of resistance were obtained by dividing the watts input into a single-phase loop of the wire by the square of the current in the loop. The lines mentioned extend in two directions from the Eddy (Tex.) substation of the Texas Power and Light Company and are operated at 22,000 volts.

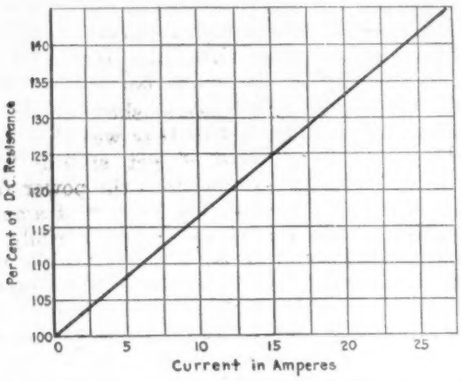


FIG. 5—ALTERNATING CURRENT RESISTANCE FOR 9/32-IN. 7-STRAND E. B. B. STEEL LINE

Iron-Wire Lines Operated by Nebraska Gas & Electric Company, Omaha, Neb.

The Nebraska Gas & Electric Company, Omaha, Neb., operates three iron-wire transmission lines. One of these lines is seven miles long and extends from Holmesville to Wymore, Neb. Another line, twenty-eight miles long, extends from Norfolk to Tilden, Neb. Although the latter line has never been operated up to the capacity of the conductors, its performance has been satisfactory. The sizes of iron wire used are 7/16 in., 3/8 in. and 5/16 in. The line is two-conductor, transposed every two miles and carried on 30-ft. wood poles spaced 125 ft. The operating voltage is 16,500 and the average load 70 kw. The third line extends from Oakland, Iowa, to Avoca, Iowa, a distance of fourteen miles. This line was built in the fall of 1915, and, since being placed in operation, has been subject to greater static disturbances than copper lines operated. Investigations are now being made to determine the causes, considering the country through which the lines pass, since another short copper line also shows similar disturbance but extends through a somewhat different type of country.

Use of Iron-Wire Lines to Serve Irrigation Motors by Pacific Power & Light Company, Portland, Ore.

To minimize the cost of providing circuits over which to supply energy to irrigation motors in sparsely-settled districts, the Pacific Power & Light Company has in a number of cases made use of No. 8 copper-clad wire and No. 8 iron wire. The former was used for the reason that it was under normal copper prices—that is, about one-third cheaper than copper wire. The experience of this company has shown, however, that future growth must be taken into consideration before adopting such construction since in many cases the load may grow to such proportions that the voltage drop in the copper-clad steel lines will be excessive. On short 6600-volt tap-offs, branch lines and other circuits where the load is light, the company has not experienced any trouble with the No. 8 iron wire construction due to excessive voltage drop.

Experience With the Use of Iron-Wire Branch Lines by Southern California Edison Company.

In the past the Southern California Edison Company has used iron wire rather extensively on short branch circuits for 11,000-volt service, where the distance did not exceed a mile and the load not more than 50 kw. It has been found, however, that there are certain operating troubles that can be traced to the use of this construction, and it has therefore been discontinued. The main objection is that often what would be expected to be only a branch circuit at the time of construction would soon develop into a main line, so that the cost of changing the iron wire under normal prices of copper to the proper size of copper conductor would far exceed the interest saved on the copper wire which would have been installed at the beginning. Also, where iron wire has been connected to a system of large capacity a number of cases have developed where due to short-circuits near the end of the iron-wire line caused by trees blowing into the line or other causes, the rush of current would be enough to thoroughly anneal the wire and often drop it to the ground at a number of places before the main circuit breaker would release.

Results of Tests on No. 6 B.W.G-BB. Galvanized-Iron Wire Line Operated at 60,000 Volts by Pacific Gas & Electric Company.

The data of the accompanying table shows results of a test on a three-phase, 60-cycle, No. 6 B.W.G.-B.B. (41,209 circ. mil) iron-wire transmission line operated at 60,000 volts by the Pacific Gas & Electric Company of San Francisco, Cal. The conductors are spaced on a 7-ft. triangle with the neutral 4 ft. from the conductors. The values in the table are based on 1000 ft. of single conductor.

Amp.	Ohmic Res.	Eff. Res.	Skin Effect Coefficient	Reactance Ohms to Neutral	Impedance Ohms to Neutral
7.2	1.96	3.54	1.8	1.80	3.97
12.2	1.96	3.94	2.0	1.83	4.34
22.3	1.96	3.80	1.9	1.90	4.24

Reasons Why Cumberland County Power & Light Company, Portland, Maine, Has Not Considered Use of Iron Wire Practicable.

Owing to the soaring prices of copper the Cumberland County Power & Light Company at one time considered temporary use of iron wire on a 20-mile, 66,000-volt transmission line for transmitting 3000 kw. between one of its stations and a new development. Realizing that there would be no market for second-hand iron wire, seven-strand, 7/16-in. galvanized-iron guy wire was the only size considered, it being contemplated that when the price of copper did drop to a value where it would be advisable to replace the iron wire with copper, the iron wire could be used for maintenance purposes. However, it was concluded that a bank of transformers which would not have been necessitated for five or six years later would be required. This and the fact that the first investment, probably $7000 or $8000 for wire, and the yearly fixed charges would have made the iron-wire construction more expensive than copper without giving any corresponding advantages, caused the company to give up the idea. If the permanent use of iron wire had been considered practicable the tower spacing might have been changed to make the construction economical in the long run. However, in view of the considerable increase in amount of power which would have to be transmitted over the line ultimately, iron wire could not be considered for permanent usage. Several other cases where iron wire might have been used have come to the attention of the company, but each time it has been concluded that it would not be advisable for the reasons mentioned.

STATION AND OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Fuse-Changing Stick Used by Georgia Railway & Power Company

Because of the construction of most high-tension fuse-changing devices, it is impossible to remove a fuse from its clips without the aid of an auxiliary stick used to prevent the fuse from falling out of the jaws. Furthermore, when inserting a fuse, it must usually be attached to the jaws with tape so that it will not fall out during the operation. This method has the objection that the tape must be cut after the fuse is in place to permit withdrawing the fuse changer. To avoid such inconveniences, the department of tests and repairs of the Georgia Railway & Power Company, under the direction of E. P. Peck, has developed a fuse-changing device which can be used even when fuses are not easily accessible. It consists of a remodeled casting from a General Electric fuse changer attached to the end of 5-ft. hickory handle 1 in. in diameter. The hickory was dried in a bake oven, painted with air-drying varnish, and then baked again to harden the varnish. As shown by the accompanying drawing, the casting was cut and rebrazed so that the fuse-holding jaws are at 45 deg. with the handle. Setting them at this angle has made it convenient to slip the jaws over a fuse without standing directly in front of it. To hold the fuse in the jaws a pivoted finger was attached to the casting. The finger can be moved to cover or uncover the opening in the jaws by means of a string attached as shown and run through screw eyes on the casting and at one end of the handle. A spring holds the finger in either extreme position so that the operator does not have to maintain tension on the string. Being strongly constructed and equipped as described, there is no chance of the fuse falling out of the jaws. Furthermore, the long handle permits the operator to stand several feet from the high-voltage equipment, thus eliminating practically all hazard in changing fuses.

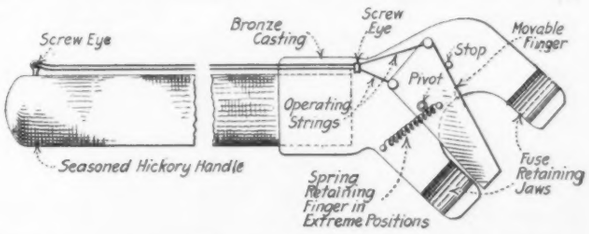


FIG. 1—CONSTRUCTION OF JAW ON FUSE-CHANGING STICK

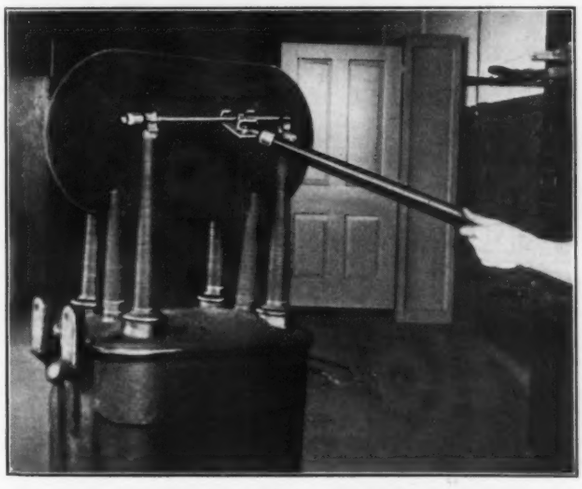


FIG. 2—METHOD OF USING FUSE-CHANGING DEVICE

Use of Motorcycles by Meter Departments of Roanoke and Lynchburg Companies

For handling trouble calls and installing meters the meter departments of the Roanoke (Va.) Railway & Electric Company and the Lynchburg (Va.) Traction & Light Company now use motorcycles with a side-car attachment as shown in the accompanying illustration.

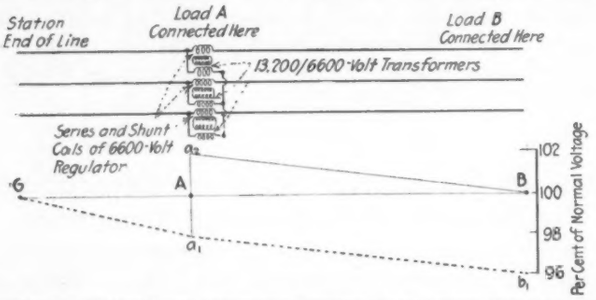
MOTORCYCLE EQUIPPED FOR USE BY METERMAN

Since these machines have been in use by the men who set and remove meters a prompter trouble service and new-connection service has been possible according to John W. Hancock, general manager of both companies. Mr. Hancock also states that fewer men are required to handle the work when using the machines. In Roanoke, for instance, one man now installs and removes all meters while two were formerly required.

How Placing Regulator Between Delivery End of Line and Station Improved Voltage Conditions

The load on one of the 13,200-volt suburban lines radiating from a Middle West city recently became so large that the voltage on the delivery end dropped considerably below the no-load voltage during peak loads. Since the contracts for service did not permit a variation of more than 2 per cent above or below normal voltage, it became necessary to devise means of remedying the trouble. Substitution of larger conductors for those in use or raising the transmission voltage was out of the question because of the expense and delay

incidental to installing the necessary equipment. About the only thing left to do was to install voltage regulators. Conditions were therefore studied to determine how many regulators would be required, what their ratings should be, and where they should be placed. A survey of the pressures at different points along the line during peak load showed conditions similar to those indicated by the accompanying chart. Since by contract 2 per cent deviation from normal voltage was allowed, it was decided that only one regulator, with a maximum range of 4 per cent normal voltage, would be required if placed at the point marked *A* on the accompany diagram. This would boost the voltage at *A* 4



VOLTAGE CONDITIONS EXISTING BEFORE AND AFTER INSTALLING REGULATOR

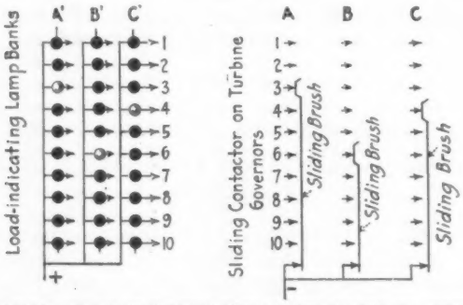
Line G-a_1-b_1 shows the percentage of normal voltage existing at different points along the line during peak loads before the regulator was installed. Lines G-a_1, a_2-B indicate the condition which existed after the regulator was in operation. Instead of deviations ranging from zero to 4 per cent below nominal, only zero to 2 per cent exists with the regulator in circuit.

per cent during peak loads, making the actual voltage at *A* 2 per cent above normal and at *B* exactly normal. With this arrangement the voltage at every point along the line is maintained within the permissible limit.

Since no 13,200-volt regulators were kept in stock by the company, and since it could not wait for the delivery of such apparatus from manufacturers, it was decided to adapt 6600-volt regulators which were in stock to the service. This was done by connecting 13,200/6600-volt transformers across the line at the place selected for the regulator and joining the higher voltage transformer terminals with one element of the voltage regulator. The other regulator element was connected as usual in series with the line.

Boiler-room Load Indicator Operated by Turbine Governors

To enable firemen at the station of the Massillon Gas & Electric Company, Massillon, Ohio, to handle the load



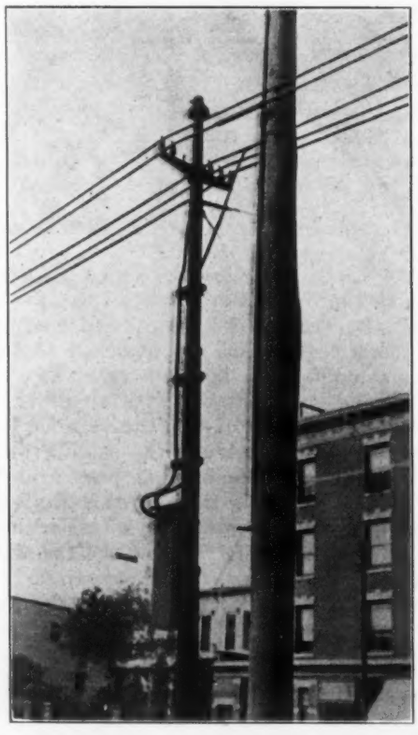
CONNECTIONS OF LOAD-INDICATING LAMP BANK TO GOVERNOR-OPERATED MECHANISMS OF THREE TURBINES.

on boilers in accordance with the fluctuating steel-mill load carried by this company an automatic load indicator is employed in the boiler room. It consists of three rows of ten lamps each, one terminal of each lamp being connected with the positive side of the energy-supply source. The remaining terminals are connected at contact panels on three turbine governors, only lamps of the same row being connected with the same panel. Attached to the governor shaft and connected with the negative side of the supply circuit is a copper brush arranged so that it slides over the contacts connected with the lamp bank. As the load varies and the turbine governor moves up or down it causes the brush to touch a certain contact lighting the corresponding lamp. When calibrated the lamp bank indicates to the firemen the load on each turbine as well as the total load.

A Method for Supporting Sectionalizing Taps on Heavy Feeder Lines

BY G. H. MCKELWAY

In the issue of the ELECTRICAL WORLD dated April 17, 1915, there was described and illustrated a method used by an Indiana lighting and railway company for supporting sectionalizing taps on heavy feeders. In this method the legs leading from the feeder to the switch were supported from a short cross-arm, attached to the



A CONSTRUCTION THAT SECURELY HOLDS WIRES BETWEEN FEEDERS AND SWITCH BOX ON A POLE

pole at right angles to the line arm and considerably lower, by short hangers presumably made of galvanized-iron span wire and held to the feeder legs by means of clamps and to the cross-arm by eye bolts passing through the arm. The legs were insulated from the arm by means of wooden strain insulators.

The accompanying illustration shows an arrangement used by an Eastern railway which appears to the writer to be an improvement upon the method previously described. It will be noticed that, instead of a single arm attached to the pole, three arms have been so placed, and by their use a much neater-appearing layout has been made than that illustrated a year ago. There is not the opportunity for too much slack being left in the legs, for the wires remain close to the pole the entire way down from the feeder to the switch box.

In the sketch accompanying the previous article both legs from the feeder were shown entering the box from the bottom, while here both enter near the top and just over the door. The first plan necessitates one of the wires being brought up to the upper terminal of the switch inside of the box and close to the switch blade, requiring a larger box and more wire than with the method shown in the accompanying illustration. If proper drip loops are made in the wires where they enter the box they should be just as safe from trouble due to moisture as if they came in at the bottom, while the appearance is much improved by bringing both in at the top.

In a modification of the method just described the wires are attached to the arms by means of porcelain spool insulators held in place by lag screws. This makes just as safe a construction, but not quite so neat a one, as when the wires pass through holes drilled in the arms. Again, instead of having the leads to the terminals pass into the box either at the top or the bottom of it, they are sometimes made to enter through holes bored in the sides of the box just opposite to the location of the switch lugs. In this plan the wires are attached to the side of the box just outside of the hole by the use of spool insulators, and the wires passing around these insulators are in that way provided with the necessary drip loops to keep water from entering the switch box. This allows of the use of the smallest possible box as the wires are not inside of it except immediately at the terminals.

Method of Erecting and Equipping Heavy Street Lighting Posts

The methods of erecting and equipping lamp-posts for the demonstration installation in Milwaukee, described in the March 18 issue of the ELECTRICAL WORLD, are indicated in accompanying illustrations. The poles were delivered on trucks, from which they were unloaded and erected by the portable derrick shown in Fig. 1. This derrick consists of a jib about 25 ft. long hinged at the lower end to a vertically pivoted timber suspended from a tripod attached to the truck frame. To convey

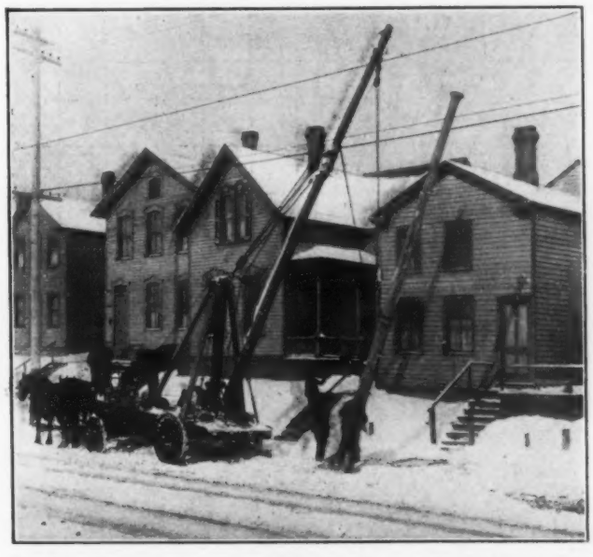
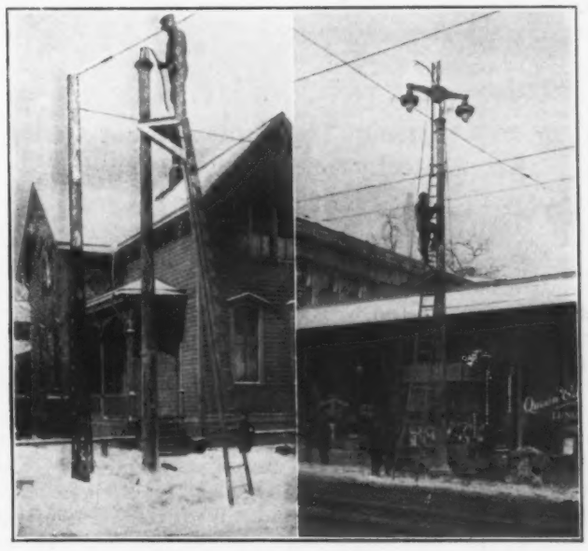


FIG. 1—PORTABLE DERRICK BEING USED TO ERECT LAMP-POST

the stress imposed by the tripod legs to the ground without straining the truck frame more than necessary, the tripod was attached to the truck so that one leg rests on the frame near the front-axle pivot and the other two next to the ends of the rear axle. Between a point about two-thirds out on the jib and the top of the tripod were connected blocks and tackle the free end of which passes through a pulley near the jib hinge and finally around the drum of a hand-operated winch. This equipment is used for adjusting the angle at which the jib was held. Since the jib-holding tackle produces an upward stress, guy cables and turnbuckles were used to transmit the stress from the top of the tripod to the wagon frame.

The tackle for hoisting and lowering the lamp-posts into their bases, is attached to the free end of the jib and passes through a pulley near the base and thence around the drum of the hand winch. Auxiliary blocks and tackle were sometimes connected between the jib head and a point on the lamp-post between the top and the main tackle attachment to facilitate lifting the poles off the trucks and relieve the severe stresses which would have been caused in the pole by supporting it at only one point.



FIGS. 2 AND 3—EXTENSIBLE PLATFORM LADDER AND METHOD OF HOISTING LAMP-POST FIXTURES

In Fig. 2 is a pole which has been set in its cylindrical-shaped concrete base, grouted in place, and the lamp circuit connected with the underground circuit through an axial conduit ready for attaching the lamp fixture. The platform at the top of the ladder is securely attached thereto so that both may be moved as a unit from one pole to another. Being extensible, the ladder can be used on different-height poles.

Since the fixtures were too heavy for men, unaided by mechanical means, to lift in place, the arrangement shown in Fig. 3 was used. The apparatus includes a straight piece of pipe clamped vertically to the pole in two places as shown, so that it extends several feet above the head of the lamp-post. At the top of the pipe is attached a bracket from which the block and tackle for hoisting the lamp fixture are supported. The installation of these units was performed by the Langstadt & Meyer Construction & Supply Company, Appleton, Wis.

Pole Test Stations for Voltage Surveys

To provide means of ascertaining whether proper voltages are being maintained at various points on its distribution system, the Philadelphia Electric Company has connected the secondary terminals of each distributing transformer installed on poles with a plug receptacle that may be readily joined with a portable voltmeter

when voltage readings are desired. Each receptacle is attached about 8 ft. above the base of the pole on which the transformer is mounted so that it will be out of reach of unauthorized persons. In order that inspectors will not be inconvenienced by this location, however, each one is provided with a telescoping rod with a clip on one end in which the voltmeter terminal plug may be clamped to insert it in the receptacle. The test circuits, which consist of No. 14 wires, are fused at the transformer end and protected by conduit. The receptacles are inclosed in weatherproof coverings. Thus the installation is made inconspicuous, the danger of transformer short-circuit minimized, and operations of linemen uninterfered with. Furthermore, consumers are not annoyed by inspectors taking voltage readings in their homes as is done by some companies when answering complaints or making voltage surveys. It may be pointed out, however, that when consumers insist on having the voltage measured at their sockets the Philadelphia company employs small flat-fiber plugs, which may be inserted in any lamp socket without removing the glassware.

How to Determine the Amount That Can Be Economically Spent for Remedying Plant Defects

It is usually an easy matter to ascertain whether blow-off valves are leaking, or how much scale is on boiler tubes, or how many feet of steam pipe are uncovered, but it is not so simple to determine how much can be spent to remedy these defects. While computations based on exact local conditions are the most accurate method of analyzing the latter, fairy reliable estimates can be made of losses resulting from the above-mentioned causes by means of information in the form of curves such as are here reproduced and were presented by Charles Brossmann, consulting engineer, at a convention in Indianapolis, Ind. With the value of the losses known it involves only good economic judgment to determine how much can be spent for improvements.

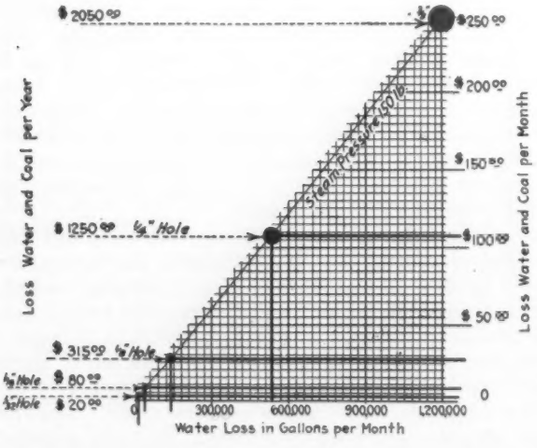


FIG. 1—GRAPHICAL REPRESENTATION OF LOSSES CAUSED BY LEAKY BLOW-OFF VALVES

It may be pointed out in connection with the curves shown that, at a steam pressure of 150 lb. and with coal costing $2 a ton, water costing 5 cents per 1000 gal., and a blow-off valve with a ¼-in. leak, the loss due to coal and water per year is $1,250. Several such leaks, it can be seen, would cause a loss comparable with many officials' salaries. Again, with coal at the same price, a load which requires a consumption of 10 tons of coal a day and ⅛ in. of scale on the boiler tubes, the loss would be $1,000 a year, to say nothing about the decreased ability of the boiler to carry overloads.

Heat loss from uncovered steam pipes is also larger than many operators may believe. For instance, assume that a plant operates with coal containing 13,000 B.t.u. and costing $1.75 a ton, a boiler and grate efficiency of 60 per cent, and a steam pressure of 125 lb.

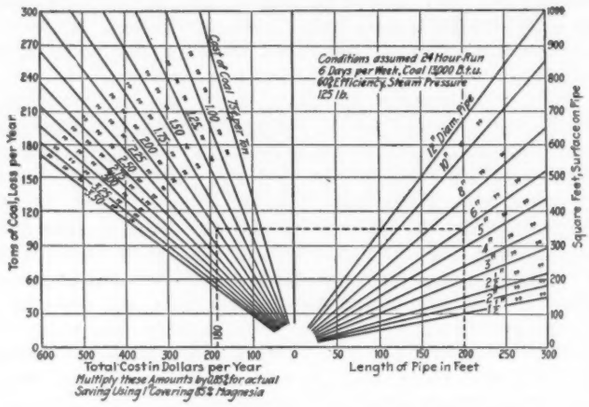

Conditions assumed 24 Hour Run
6 Days per Week, Coal 13,000 B.t.u.
60% Efficiency, Steam Pressure
125 lb.
Cost of Coal $1.75 per Ton
Tons of Coal, Loss per Year
Square Feet, Surface on Pipe
Total Cost in Dollars per Year
Length of Pipe in Feet
Multiply these Amounts by 0.85 for actual Saving Using 1" Covering 85% Magnesia

FIG. 2—CHART SHOWING LOSSES CAUSED BY UNCOVERED STEAM PIPES

Then, according to the curves, 200 ft. of uncovered 6-in. steam pipe will radiate enough heat in one year of six days per week to cause a loss of $180, of which 85 per cent can be saved by covering the pipes with a 1-in. jacket of magnesia.

Correction of some defects produce such large benefits that it is advisable to consider them irrespective of the expense of making them. In this class may fall the sealing of boiler settings and baffles to prevent air leakage and the short-circuiting of furnace gases, removing soot and ashes from the boiler tubes and breeching to facilitate transfer of heat and improve draft, cleaning feedwater heaters to insure efficient operation and the like. Faulty methods of operation are frequently as

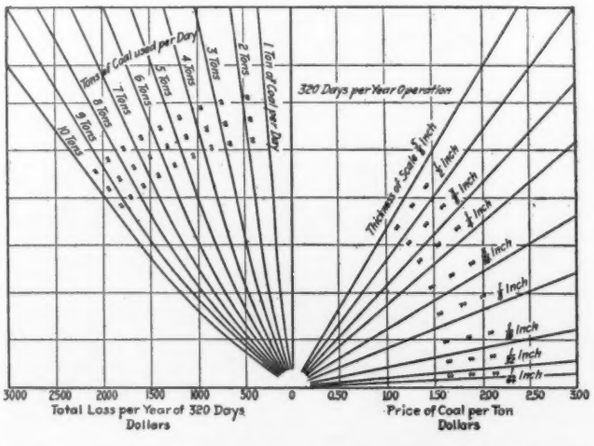

Tons of Coal used per Day
320 Days per Year Operation
Thickness of Scale
Total Loss per Year of 320 Days
Dollars
Price of Coal per Ton
Dollars

FIG. 3—LOSSES PRODUCED BY DIFFERENT THICKNESSES OF SCALE ON BOILER TUBES

much the cause of poor plant economy as defects in apparatus. For instance, excessive air leakage may be caused by regulating the draft by fire doors instead of ash doors, and steam and consequently coal may be wasted by improperly set safety valves. Also, maintaining the proper thickness of fuel on the grates assists in minimizing the amount of heat lost up the chimney.

MARKETING ELECTRICITY

A Department on Selling Service and Widening the Use of Electrical Energy

A Dealer's House-to-House Appliance Campaign

How the Louisville Central-Station Company, Which Does Not Handle Merchandise, Is Putting Electric Irons and Toasters on Its Lines with the Help of the Dealer's Sales Crew

BY ROBERT MONTGOMERY

Manager Commercial Department, Louisville (Ky.) Gas & Electric Company

There is some diversity of opinion among central-station managers as to whether an electric-service company should sell appliances or whether it should leave that business to the dealers. Certain central-station managers argue that appliance dealers cannot successfully sell appliances or successfully conduct appliance-sales campaigns. The campaign now being conducted in Louisville by the Tafel Electric Company shows conclusively, however, that when a dealer launches a campaign along intelligent lines and receives the co-operation of the central station he is bound to be successful.

In general the plan for operating the campaign referred to was worked out as follows: The Louisville Gas & Electric Company agreed to co-operate with the Tafel Electric Company in every way possible, provided the Tafel company would maintain a soliciting force of not less than nine house-to-house canvassers, to be paid on the following commission schedule: Each man to receive a salary of $6 per week plus a commission of 25 cents per iron for the first twenty-four irons sold per week, and 50 cents per iron for all sold in excess of twenty-four irons per week. Under the terms of the arrangement the Tafel company guaranteed to solicit every domestic electric consumer connected to the Louisville Gas & Electric Company's lines.

PREPARING FOR THE CAMPAIGN

In Louisville we have about 24,000 residence electric customers. Before this campaign started there were over 9000 electric irons in use. At the beginning of the campaign our company made up a list of the names and addresses of these 24,000 residence lighting consumers. The name and address of each customer was typewritten on a card, and these cards were numbered with a numbering machine to insure their being kept in proper order in the file.

After the sales staff of the Tafel company had been organized the city was divided into nine definite sections, each man being assigned to a district. The cards for each district were filed separately.

CUSTOMER CARD	Has Iron		INTERESTED IN	WHEN
	Sold for Cash			
Name	Sold on Payment			
	Wants Scout			
Address	Could not see			
Telephone No.	Call later			
Salesman No.	Did not want Iron. Why?			

ON CARDS LIKE THIS THE NAMES OF ALL OF THE CUSTOMERS OF THE LOUISVILLE GAS & ELECTRIC COMPANY WERE TRANSCRIBED. THE CARDS WERE NUMBERED CONSECUTIVELY BY MACHINE AND WERE USED BY THE SALESMEN AS GUIDES

When a salesman starts out in the morning he takes from the file about fifty of these cards, and calls on the customers in the order in which they were numbered. This procedure gives assurance that the solicitor will follow the route of the company's meter readers, saves many steps, and enables the salesman to walk up to house doors and call the occupants by name. Each solicitor has been required to fill out completely the information asked for on each of these cards. He offers a West-

STORE OF TAFEL ELECTRIC COMPANY WHERE TRAINED SALESMEN GIVE COURTEOUS ATTENTION TO CUSTOMERS' WANTS

THE CAMPAIGN TEAM OF TAFEL ELECTRIC COMPANY STARTING OUT TO CALL ON THE HOUSEWIVES OF LOUISVILLE

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

H. C. Tafel Electric Co., Inc.
236 West Jefferson Street

Louisville, Ky. 1916

Please send me one of your **WESTINGHOUSE ELECTRIC** { $2.25 Radiant Toaster / 3.00 6-lb. Iron. / 3.75 Turnover Toaster }

for which I agree to pay 50 cents upon receipt, and 50 cents each month until same is paid for in full, these payments to be made at our office.

My failure to make payments as above will signify my willingness to return same in full settlement of unpaid balance

Should I decide to pay cash in full upon delivery of the above I will be allowed a special 10% discount.

Guarantee It is understood that you and the Westinghouse Co., guarantee all parts of the above for one year and the heating element FOREVER if operated under normal conditions and at voltage which I am now using.

Received today ..... 1916, according to above conditions one

..... in good order and made { first 50 cents / full $..... less 10% } payment

Salesman ..... No. ..... Tel. No. .....

THIS CARD REPRODUCES THE CONTRACT FORM COVERING THE SALE OF THE DEVICE. THE NUMBERS ACROSS THE TOP INDICATE THE DAY OF THE MONTH WHEN THE CUSTOMER'S PAYMENTS FALL DUE

inghouse electric iron, guaranteeing the heating element for life, for $3 payable 50 cents down and 50 cents a month, or $2.70 for cash. He also offers a turnover toaster for $3.75, on terms of 75 cents down and 50 cents a month, or 10 per cent off for cash.

When a customer will not place an order for an iron the solicitor makes an effort to have the customer sign an orange-colored card requesting that an iron or toaster be sent on one week's free trial. If, on the other hand, the customer decides to place an order directly for either of the foregoing devices, a yellow card is signed. The figures at the top of the cards represent the days of the month, and in the file a little clip is attached at the top of the card indicating the day of the month upon which the customer's payments fall due.

By using this card system it is necessary for the salesmen to call on every customer, a procedure which might not be carried out otherwise, for when calling on every house is not compulsory a house-to-house canvasser often passes by certain houses because they do not look like good "prospects."

When the entire city has been thoroughly covered it is the intention to start the salesmen over the same routes again. The second time, however, they will call on only such customers as have no irons, as indicated by the customers' cards, which will be filled in by the salesmen during their previous solicitation of the territory.

This campaign has been in operation since Feb. 1. The salesmen made practically no sales during the first ten days they were out, for they were all green men and a week or more was required to train them to work intelligently.

A LITTLE LESSON IN THE ART OF "APPROACH"

To illustrate the difference between a trained canvasser and an untrained one, attention might be called to the increase in sales that was obtained by merely correcting the salesmen's approach to their customers. During the first ten days it was noticed that about 70 per cent of the customers' cards that were turned in by the salesmen bore the notation that the customer had an electric iron. Upon investigation it was found that the salesman opened the conversation with his "prospect" something as follows:

"Good morning. Have you an electric iron?"

The prospect naturally said "yes" in order to get rid of the salesman. When the salesman's opening conversation was changed to something like the following, however, there was a noticeable decrease in the number of irons reported in the possession of the customers and a big increase in the sales. The approved form of approach now is: "Have you seen this new electric iron which is guaranteed for life?"

In the first month of the campaign the nine salesmen sold 733 irons and toasters. About 30 per cent of these were disposed of for cash. The Tafel company is doing no advertising of any kind, but is depending entirely upon solicitation to secure this business.

The Louisville Gas & Electric Company has a large basement under its office building where the commercial department frequently holds meetings of its employees, and during the present appliance campaign we are allowing the Tafel company to use this basement to hold meetings of its crew of salesmen. The dealers' salesmen meet in this basement every morning at 8 o'clock, and are coached by Mr. Allen, the sales manager of the Tafel company. The comparative results produced by each man daily and weekly are shown on a large blackboard, and the contest has naturally aroused considerable rivalry among the men.

ONE OF TWO SHOW WINDOWS MAINTAINED ON THE PRINCIPAL BUSINESS STREET OF LOUISVILLE DURING THE FIRST THIRTY DAYS OF THE SALE

The buildings were vacant at the time and the owner of the property, realizing that a tenant could be found more readily for the building if the windows were lighted, allowed the Tafel Electric Company to use them free of charge.

How Advertising Matter Inclosed with Monthly Lighting Bills Helped Sell 800 Vacuum Cleaners

The Portland (Ore.) Railway, Light & Power Company has just completed a series of three six-week campaigns for the sale of vacuum cleaners, which were carried on almost exclusively by aid of circular matter inclosed with the customers' lighting bills. This plan, which did not even involve outlay for postage, put on the company's lines new business totalling 960 kw., most of which is classified under the 4-cent lighting rate.

The plan was to describe several combinations involving vacuum cleaners, iron, toaster, percolator, etc., with the announcement that by a special arrangement with the manufacturers the groups could be sold to the customers for a limited time at $39. The several items and combinations were explained in a folder inclosed with the bill, and the list prices of the items in each combination were stated, the groups being arranged so that the total list price of each amounted to $50. A coupon was attached which was accepted by the company during the campaign at its face value of $11 in part payment for any set, thus making the actual price to consumer $39.

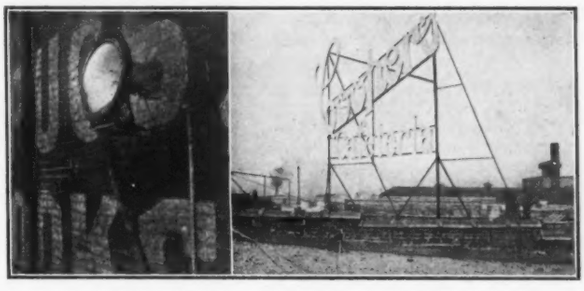
Some advertising was done in the daily newspapers to accentuate the circular matter, but no salesmen were specially assigned to the work. Prospective customers came in considerable numbers to the demonstrating room, where samples of all appliances were kept on demonstration.

Orders were booked rapidly on a payment plan of $3 down and $3 per month, and as a result of these campaigns thus far held 800 groups have been sold under the combination offer. The gross profit to the company in these transactions was about $4,800 on the total $31,200 received. From this should be deducted a printing bill of $252 and about $450 for newspaper advertising, leaving a net profit of over $4,000.

The campaigns have been conducted under the direction of A. C. MacMicken, sales manager for the company.

Single 500-Watt Flood Lamp Lights Large Restaurant Sign

A local sign manufacturer in Champaign, Ill., has built and erected a cafeteria sign measuring approximately 18 ft. long and 10 ft. high which is effectively lighted with one lamp. This sign rests on the roof of the restaurant it advertises, at an angle to the street on which the building fronts. The 500-watt lamp which



THE 500-WATT PROJECTOR AND THE SIGN IT LIGHTS

lights it is placed in a projector mounted on an improvised bracket against a higher adjacent building so that the lamp and the lower word of the sign are at about the same level. The service wires for the sign are brought through the meter and control switch in the restaurant building to the roof, and a conduit run about 100 ft. in length has been laid over the adjoining roofs to the lamp. The fact that the sign was inexpensive both in first cost and in maintenance permitted the owner of this small business to use electric advertising which he would otherwise have considered too costly.

Economies of Industrial Electric Heating

Installations of electric heating apparatus in industrial plants on the system of the Narragansett Electric Lighting Company, Providence, R. I., last year illustrate the striking advantages of this form of service over gas and other furnaces. The essential points in seven installations are given below.

1. Enameling furnace. Muffle, 6 in. x 10 in. Requires 2.5 kw. Temperature, 1550 deg. Fahr. Cost of operation at 3 cents per kilowatt-hour less than gas furnace of same size. Requires no blower, no ventilator; no dust falls on work; little external heat is evolved; and work is more uniform and of better quality than in older methods. Life of muffle, 2500 hours.

2. Special heater for tentering machine on silk goods. Surface 36 in. x 36 in., temperature 900 deg. Fahr. Requires 32 kw. Intense local heat without fire risk, and results could be obtained in no other known way.

3. Chain soldering machine. Capacity 3000 ft. fine chain daily. Requires 1.5 kw. Owing to perfection of heat control and heat indication, the work is more uniform than by any other method.

4. Mesh soldering furnace. Muffle, 16 in. x 22 in. Operation requires 4 kw. Temperature required is 1600 deg. Fahr., results in uniform heating and perfect control impossible in gas furnace.

5. Rosin melter. Tank holding 250 lb. Energy required, 6 kw. Heats full charge up to 400 deg. Fahr. in two and one-half hours. Rosin still liquid enough to run from spigot thirty hours after current is cut off, owing to system of heat insulation impossible in other types of heaters. No fire risks if rosin boils over.

6. Tempering furnace. Muffle, 16 in. x 24 in. Requires 5 kw. Heat uniform at all parts of muffle and control perfect. Specially designed for large quantities of small work where accuracy is essential. Gas-heated furnaces tried but unsatisfactory. Cost of operation about same as gas, on 4 cents per kilowatt-hour rate.

7. Furnace for silver deposit on glassware. Muffle, 24 in. x 30 in. x 36 in. Requires 25 kw. Heat uniform and no sulphur fumes to discolor work.

City Folks and the Electric Incubator—An Easter-Time Suggestion

In discussing methods of increasing the energy consumption of small residence customers at a convention of Ohio salemen, G. A. Lowther of Sandusky, Ohio, laid great stress on the importance of the electric incubator business. The manufacturers of these inanimate chick hatchers all declare, said Mr. Lowther, that more than 50 per cent of their product is sold to city people, that is, to people who have electricity available. Farmers, contrary to the popular supposition, are not the greatest incubator purchasers. Mr. Lowther suggested that it will pay every central-station company to put an electrically-heated incubator in its show window. The eggs should be placed in the incubator so that the first chickens will arrive just before Easter Sunday. Easter this year falls on April 23.

"More Effective New-Business Results Obtained with One-Half the Effort" Through the Local Electrical Contractor

The Charleston-Isle of Palms Traction Company, which furnishes electric-lighting service to the Isle of Palms, near Charleston, S. C., directs its new-business efforts entirely through the local electrical contractors and supply houses. The company employs no salesmen, since, according to W. W. Fuller, general superintendent, it has been found that one-half the effort and expense applied through the contractor and supply dealer accomplishes more effective results in securing new contracts. Reproduced herewith is a letter sent out by one of the local contractors and supply dealers of electrical goods to a prospective customer.

RUBIN ELECTRICAL COMPANY

Manning J. Rubin, Mgr. 190 Meeting Street, Charleston, S. C.

DEAR SIR—It will interest you to know that under a special arrangement with the Isle of Palms Traction Company we have unusual facilities for improving electrical service at the island during the coming season.

Why not let us inspect your place on the island to see if any repair or new work is necessary? The new rules of the insurance companies are very strict in regard to wiring, and it might prove to your profit to have us investigate and see if anything is necessary.

If you need any repairing or new work, it will pay you to let us

take charge of it. Not only is our scale of charges moderate and our work thoroughly expert, but by working in conjunction with the lighting company we will have a service in general superior to the average. If you want your house connected and a meter installed, let us know now so that we can attend to it before the rush.

There will be an unusual amount of work this season and we should like to attend to your wants before the rush starts. Now is the time to make arrangements, don't you think so?

A telephone call, a card, or a message will bring you full and free information. 'Phone 708.

Why not prepare in time?

Yours very truly,

An Estimate of the Comparative Cost of Concentric and Knob-and-Tube Wiring

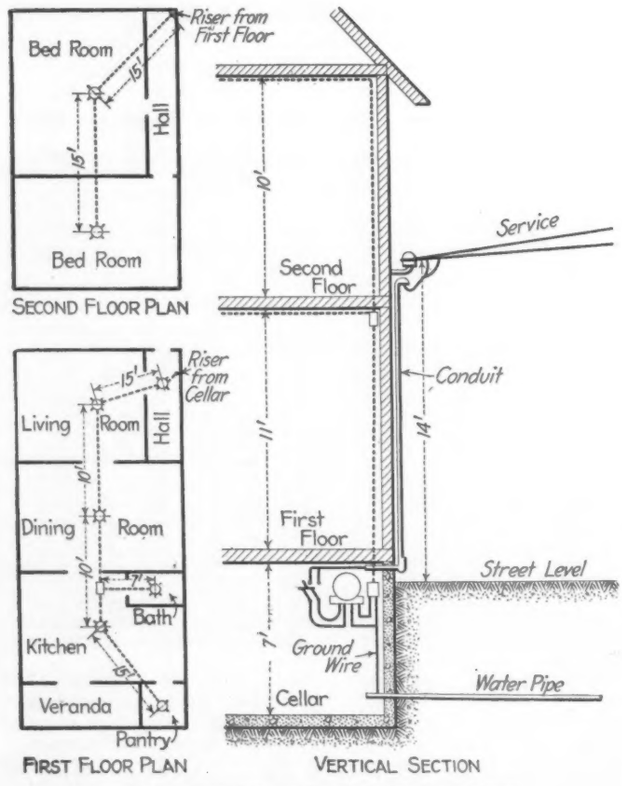
The comparative cost of wiring a five-room dwelling of single-floor construction for eight outlets, with concealed knob-and-tube work and with bare concentric wire, as estimated by F. J. Lyon, superintendent of the United Electric Light & Water Company, Waterbury, Conn., is shown in the accompanying tables, presented by him before a recent meeting of the local N. E. L. A. section at Hartford, Conn. The comparison as made favors the concentric-wiring system, showing a saving of about 10 per cent. In commenting on the figures, Mr. Lyon said:

"I have been rather conservative in my estimate in the case of the knob-and-tube system, and also believe that in actual practice the cost of the bare concentric system will be considerably less than that estimated in the present single case.

"With the concentric system a supporting base for fixtures is used, which renders the labor of hanging fixtures very much less and would therefore cut down the fixture-hanging cost to some extent. The concentric-wire installation also eliminates the necessity for breaking through the center of the ceiling for ceiling outlets, and the only place the ceiling is pierced is in one inconspicuous corner where the riser enters."

Where trial concentric installations are to be made, Mr. Lyon pointed out, the workman should follow the recommendation of the committee on concentric-wiring systems of the National Fire Protective Association, requiring that the outer sheath or conductor be permanently and effectively grounded at or near the point of support of the concentric-wire system and on the house side of the service switch and fuses.

"Coming now to our own situation here in Connecticut," said Mr. Lyon in conclusion, "I personally feel that every central station in the State ought to take up the matter vigorously and, subject to the approval and under the supervision of the Underwriters' inspectors, make, say, a half-dozen trial installations in each city or town served, inviting the local contractors to cooperate to the extent of having their men do the actual work, the central station furnishing the material. In this way I believe the contractors will become interested and realize the possibilities of business, and once the demand for the wire and fittings is created I believe the price will be lowered so that everybody interested may make a profit, enabling the modest customer to take advantage of something that he wants, the contractor to land more jobs and the central station to serve more customers."



ARRANGEMENT OF OUTLETS IN DWELLING

TABLES COMPARING ESTIMATED COST OF WIRING FIVE-ROOM DWELLING FOR EIGHT OUTLETS WITH CONCEALED KNOB-AND-TUBE WORK AND WITH BARE CONCENTRIC CONDUCTOR

KNOB-AND-TUBE WORK CONCEALED

300 ft. No. 14 rubber-covered single-braid wire, at 70 cents per 100 ft.	$2.10
200 ft. 2/8-in. circ. loom, at $1.60 per 100 ft.	3.20
Seventy-five 3-in. by 5/16 in. porcelain tubes, at 70 cents per 100	0.53
Seventy-five knobs, No. 5½, at $1 per 100	0.75
40 ft. No. 10 rubber-covered double-braid wire (service), at .80 cents per 100	0.32
20 ft. No. 6 rubber-covered stranded wire, at $4 per 100	0.80
15 ft. ½-in. conduit, at $3.50 per 100	0.52
One ½-in. G. V. cap, at 20 cents each	0.20
One ½-in. "L" condulet, at 18 cents each	0.18
One ½-in. "A" condulet, at 18 cents each	0.18
One two-hole porcelain cover, at 10 cents each	0.10
One two-wire extension switch, at 40 cents each	0.40
One ground clamp	0.15
One meter board, cleats, nails, solder, tape, etc.	0.40
Material	$9.83
Twelve hours' labor, wireman, at 60 cents per hour	$7.20
Twelve hours' labor, helper, at 20 cents per hour	2.40
	9.60
Total	$19.43

Tools required: Regular wireman's outfit.

BARE CONCENTRIC WIRE

40 ft. No. 10 rubber-covered wire for service, at 80 cents per 100 ft.	$0.32
20 ft. No. 6 rubber-covered wire for ground wire, at $4 per 100 ft.	0.80
15 ft. ½-in. conduit, at $3.50 per 100 ft.	0.52
One ½-in. G. V. cap	0.20
One ½-in. "L" condulet	0.18
One ½-in. "A" condulet	0.18
One two-hole porcelain cover	0.10
One ground clamp	0.15
111 ft. bare concentric No. 14 wire	5.33
One No. 171,445 switch and cut-out, three-wire (two-circuit)	0.66
Ten No. 171,446 three-way junction boxes	1.80
Thirty No. 173,721 clamps	0.18
One two-wire main-entrance switch	0.40
Eight No. 171,451 supporting bases for lighting fixtures	1.44
2 ft. iron pipe for reinforcing	0.06
Nails, screws, meter board	0.20
Material	$12.52
Five hours' time, wireman, at 60 cents per hour	3.00
Five hours' time, helper, at 20 cents per hour	1.00
Total	$16.52

Tools required: Screwdriver, bending tool, special pliers, hammer, brace and one ⅜-in. and one ⅝-in. bit 18 in. long.

ADVANCE IN TECHNICAL THEORY AND PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Reclaiming Copper from Existing Plants

Reconstruction of Central Stations and Transmission Systems in Austria for the Purpose of Procuring Copper for War Purposes—Replacing Direct-Current Distribution with Three-phase High-Tension Equipment—The Price Received for the Copper Saved Pays for the Reconstruction

ON preceding pages of this issue will be found an exceedingly interesting article on the use of iron wire for transmission lines in various parts of the United States, with a discussion of those construction and operating features which tend toward economy in serving small customers. This substitution of iron for copper, wherever possible, is particularly attractive now on account of the present high price of copper. In Germany and Austria the same tendency is at present very noticeable, but there not merely economy, but necessity dictates this policy. The problem is how to get copper for war purposes; how to get it out of the existing electric stations and transmission systems without detrimental effects on their capacity, and how to make it attractive to the electric companies to give up their excess copper. The manner in which this problem has been solved in Austria is described by Otto Heller, chief engineer of the Metallzentrale Company, in *Elektrotechnik und Maschinenbau* (Vienna), of Jan. 9, 1916.

In the Austrian Department of Commerce an electrical committee has been formed which co-operates in an advisory capacity with the electric stations on these problems. The municipal electric station of Vienna has discontinued a generating plant which it had acquired from another company, and has also discontinued part of that company's distribution system and is supplying these consumers now from its own principal station and from its own mains. Some 480 tons of copper and 200 tons of lead have thereby been recovered and sold to the war department. The Vienna municipal tramways have changed from the conduit system to the trolley system and have recovered large amounts of copper. The Vienna City Railway has discontinued its own power plant and is supplied now with energy from the municipal lighting station, whereby 200 tons of copper and 600 tons of lead have been recovered.

The Etsch Works have discontinued the overhead transmission line from Meran to Bozen (40 km. or 24 miles) and have recovered 30 tons of copper. This overhead line was a reserve for the cable line, which has been left intact, but it also supplied service to towns along the line; these are now supplied from a new iron-wire transmission line, while, in order to procure a new reserve for Bozen in case of a cable breakdown, the Bozen supply system has been interconnected with the Zwölfmalgreien supply system.

Heller describes in some detail the reconstruction of the Abbazia central station. This was opened in 1896 as a direct-current 300/150-volt, three-wire plant, but the rapid development of the Austrian Riviera necessitated a large increase of the supply net work to adjoining towns. Further extensions of the plant were therefore made with three-phase current at 5000 volts and 15 cycles supplied to three storage-battery substations, the distribution being by the three-wire direct-current system partly at 300/150 volts and partly at 240/120 volts. As in similar plants in which the direct-current system has been maintained as long as possible, copper conductors of large cross-sections were here available. This is the reason why the complete reconstruction could be made to pay. For the new plant three-phase distribution is used throughout, the primary voltage being 5000, the secondary 380/220. The old plant contained 71 tons of copper and 141 tons of lead; the new plant contains 15 tons of copper and 27 tons of lead. Hence the balance of the copper and lead was available for sale and was sold at $100,000. The cost of the new plant is about the same amount, so that the reconstruction was economical because the new plant is better adapted to extensions in the future than was the old plant.

Generators, Motors and Transformers

Uniformity in Drawing Electrical Diagrams.—GISBERT KAPP.—Drawing is the language of the engineer, but the most can be made of it only if there is uniformity in the use of symbols and methods in diagrams, so that they become more self-explanatory than is usually the case. The author makes a recommendation as to the most important symbols. This is given in Fig. 1 on page 834, while Fig. 2 shows by example how these symbols may be used to indicate apparatus and connections for making a particular test—namely, the mapping out of the induction under the pole of a dynamo by means of a flux meter. In this well-known test the armature is rotated step by step, through an angle corresponding to a commutator section, and the deflection on the fluxmeter is noted when reversing the exciting current after each step. The deflection plotted against angular position of the armature gives a curve, the tangent to which at any point is proportional to the induction at that point. It will be seen that this diagram is self-explanatory, no description being required to enable anyone to set up the apparatus required for this test. In order that a diagram made up of the symbols of Fig. 1 shall not only show the different parts in their correct relation, but also explain the working of a machine, some conventional rules must be observed. These are: All dynamos, whether continuous or alternating current, are to be considered as two-pole machines. The sense in which the armature is wound is such that the current passing through the armature produces north polarity under the positive brush; or, to put it in another way, the direction of the flux produced by a current through the armature coincides with the direction of the current internally from brush to brush. The same rule applies to a distributed winding in a fixed position and surrounding the armature. Such a winding is called a compensating or a neutralizing winding, and is shown by a circle concentric with, and very little larger than, the armature circle. The brushes may be placed inside or outside the armature circle as convenient. All salient pole windings are shown by a zigzag line, as in Fig. 1, but with this difference, that

those producing a main field are drawn with wider zigzags than those used for commutating poles. The sense in which the winding is put on a core is supposed to be such that the direction of the flux produced is the same as the axial progression of the current. Series coils are shown by stouter lines than shunt coils. The direction of the emf. due to rotation is found by rotating the flux vector through 90 deg. in the direction in which the armature is driven. The direction in which the torque acts is found by supposing the vector of armature current to be a lever fixed at its tail and weighed at the head by the flux (as an aid to memory, substitute for flux or field a clod of earth from a field). As examples for the application of these rules, Fig. 3 shows a compounded generator with commutating poles. That this machine is working as a generator is seen at a glance by the direction of the curved arrows, that representing direction of rotation being in opposition to the torque arrow. If the machine were working as a motor the main current would be shown by a current arrow in the brush axis pointing to the left. The torque arrow must be shown pointing clockwise and the flux arrows of main and shunt coils pointing in opposite directions. The flux due to the shunt field would remain as before, but that due to the series winding would be opposed, the resultant being still directed upward, but reduced in magnitude. The greater the mechanical load the greater will be the reduction. The diagram, therefore, shows at a glance that a compound excited dynamo, if designed to give at constant speed constant terminal voltage if used as a generator, will, if used as a motor with constant impressed voltage, run at constant speed at variable mechanical load. The author then deals at some length with vectors and the definition of the direction of rotation in vector diagrams.—London *Electrician*, March 10, 1916.

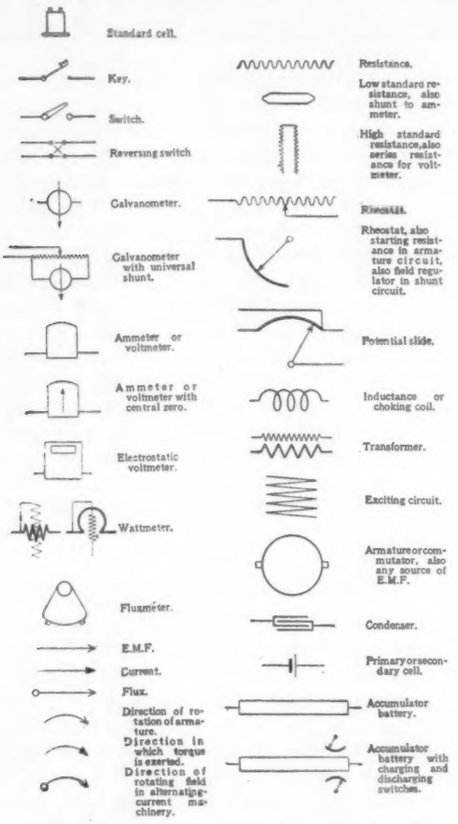


FIG. 1—RECOMMENDED FORM OF SYMBOLS FOR USE IN ENGINEERING PRACTICE

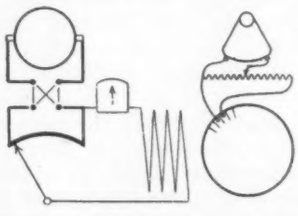


FIG. 2—SYMBOL TO INDICATE APPARATUS AND CONNECTIONS

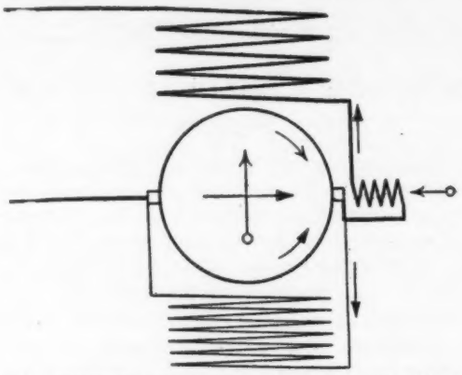


FIG. 3—DIAGRAM SHOWING OPERATION OF COMPOUND GENERATOR

Lamps and Lighting

Progress of Metallic Filament Lamps.—A diagram (Fig. 4) giving two curves showing the improvement in efficiency in the typical 500-watt metallic-filament lamp from year to year since 1911. The efficiency in 1911 is assumed to be 100 per cent as a unit. Two curves are given, one giving the efficiency on the watt per horizontal candle-power basis and the other the efficiency on the lumens per watt basis. The two curves, the watts per candle basis curve and the lumens per watt curve, are parallel up to the points where the half-watt type of lamp was introduced. Here the curves diverge, and this divergence is due to the difference in distribution of light given by the half-watt type of lamp filament as compared to the standard vacuum-type filament. For the same horizontal candle-power the half-watt filament gives more light than the vacuum type in other directions than the horizontal. On the basis of efficiency expressed in watts per mean horizontal candle this increased light from the half-watt type is not given consideration. When, however, the lamps are rated in terms of lumens, *i.e.*, lumens per watt basis for efficiency, full justice is done to the new half-watt type lamp. The increase in efficiency of light production

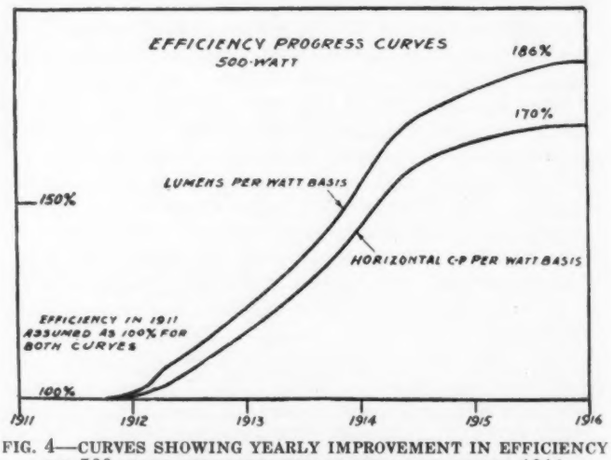


FIG. 4—CURVES SHOWING YEARLY IMPROVEMENT IN EFFICIENCY IN 500-WATT METALLIC-FILAMENT LAMP SINCE 1911

produced by the new half-watt type is therefore shown to be greater than what the watts per candle increase in efficiency indicate. As is well known, the maximum amount of light in the case of the ordinary vacuum-type metal filament is given in a horizontal direction. In the case of the latest small sizes of half-watt lamps with horizontal ring-shape filament, the maximum candle-power is given vertically, and the minimum in the horizontal direction.—London *Electrician*, March 10, 1916.

Tungsten Filament; Mechanical Equivalent of Light.—IRVING LANGMUIR.—A long paper on the results of an extended investigation of the characteristics of tungsten filaments as function of temperature. The author discusses the various functions which may be used in estimating the temperature of a tungsten filament and gives experimental data on the volt-ampere-candle-power characteristics of tungsten filaments as functions of temperature and the dimensions of the filament; he also gives derived functions such as watts, ohms and watts per candle over a range of temperature from room temperature up to the melting point of tungsten. Data on the specific resistance of tungsten from 300 deg. to 3540 deg. are also given and the total emissivity of tungsten is calculated. The intrinsic brilliancy of a black body as a function of the temperature is calculated in terms of the mechanical equivalent of light from Nutting's visibility data, by means of the Planck equation. By comparing these results with the experimentally determined brilliancies of tungsten and correcting for the known emissivity of tungsten, the mechanical equivalent of light is found to be 0.00121 watt per lumen. This is close to the value (0.00125) calculated by Ives from Nernst's data on the brilliancy of a black body, but differs considerably from Ives and Kingsbury's direct determinations of the mechanical equivalent (0.00159). The discrepancy is hard to account for. The color of the light from tungsten filaments is distinctly bluer than that from a black body at the same temperature and corresponds to that from a black body at a temperature 40 deg. to 80 deg. higher.—*Phys. Rev.*, March, 1916.

Generation, Transmission and Distribution

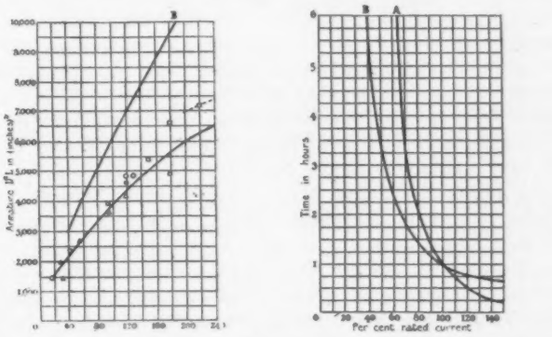
European Water Powers.—Statistics of the Imperial Russian Technical Society show the available water-power in European Russia, including Finland, the Urals and Caucasia, to be roughly 30,000,000 hp. The potential water-power of Germany is about 1,000,000 hp., that of Switzerland 2,500,000 hp., and that of Sweden more than 6,000,000 hp. Of the latter about 3,500,000 hp. is not yet utilized. In Switzerland 300,000 hp. and in Italy more than 400,000 hp. is utilized, whereas hardly 250,000 hp. is utilized in Russia.—London *Electrician*, March 10, 1916.

Electric Winding in Mines.—D. BURNS.—A paper read at a joint meeting in Glasgow of the Scottish branches of the Association of Mining Electrical Engineers and National Association of Colliery Managers, and the Mining Institute of Scotland. The author illustrates the problem by a numerical example giving the cycle of operations, a calculation of the weights, the rope, the drum, and the development of the speed diagram, the torque diagram, and the power diagram. He then discusses how to select the size of the motor and how to equalize the load by means of the Ilgner system. An account of the discussion which followed is also given.—*Iron and Coal Trades Rev.*, Feb. 25, 1916.

Variable-Speed Transmission Gear.—An illustrated description of the Williams-Janney hydraulic variable-speed gear which is being largely used for the training of turrets and the elevating of guns and for many other purposes where a wide range of speed control is necessary. The application of the gear to the revolving cantilever crane is described and illustrated.—London *Electrician*, March 3, 1916.

Traction

Direct-Current Railway Motors.—E. V. PENNELL.—A long abstract of a paper read before the (British) Institution of Electrical Engineers. Considerable progress has been made in railway motor design in reducing the weight per capacity. In Fig. 5, curve *A* represents a series of interpole designs worked out by the author, while the points indicated refer to machines in actual service (the circles referring to British designs, the squares American, and the triangles continental European). The step at the end of the curve relates to motors with duplex gears. It is interesting to compare the curve relating to railway motors with that plotted for stationary machines curve *B*. The great disparity is due mainly to the system of rating employed. Curve *B* is the Hobart's curve for direct-current machines, 600 r.p.m. From the curves in Fig. 6 it will be seen that although two different machines



FIGS. 5 AND 6—COMPARATIVE WEIGHTS AND PERFORMANCES OF DIFFERENT MACHINES

may have exactly the same rated one-hour output, efficiency, and possibly weight, their performance on runs of longer period may be radically different. Motor *A* will take much heavier loads to reach its 75 deg. C. rise than motor *B* for two, three or four hours' running. The former is representative of the recent ventilated designs, and the latter of the totally inclosed carcass motors which are only just being superseded by type *A*. The heating in actual service may be assumed to be some 15 per cent lower on account of the positive draft produced by the motion of the train. The author discusses the losses in railway motors, methods of ventilation, and the practicability of pressures of 1200 to 2400 volts.—London *Elec. Rev.*, March 10, 1916.

Electrification Schemes of Swedish State Railways.—The Swedish government has decided to ask the State Railway Department to prepare a detailed plan and calculation of costs for the electrification of the Kiruna-Lulea Railway, to ask the Waterfalls Board to prepare plans for a further exploitation of the Porjus Falls, with this electrification in view, and to ask the State Railway Department, jointly with the general staff and the Waterfalls Board, to get out a plan of cost for the continued electrification of the State Railways. The electrification of the Riksgräusen-Kiruna Railway seems to have given altogether satisfactory and encouraging results, even if the costs have somewhat exceeded the calculations. The Waterfalls Board is understood to have the plans for an additional exploitation of the Porjus Falls nearly ready, but the government, or Royal Majesty, as the official wording is in Sweden, in addition to viewing the electrification of the Kiruna-Lulea, or Svartön, Railway with decided favor, thinks the time has come to deal with the question of

the State Railways on a broader basis. A previously prepared plan by the State Railway Department for railway works up to and including the year 1923 also contains a program for the electrification of a number of State railways. According to this plan, the sections that ought to be first taken in hand are as follows: Kiruna-Lulea; Stockholm-Upsala-Krylbo; Stockholm-Gothenburg; Katrineholm-Norrköping; Järna-Nyköping; Malmö-Trelleborg and Gothenburg-Malmö. The cost of the electrification of these lines is calculated at $13,250,000, which figure, however, only covers the cost of the necessary lines and transformer-stations, but not the cost of power stations and electric locomotives. This plan will now be overhauled, and the general staff and the Waterfalls Board consulted. With regard to the generation of the vast amount of energy which such a comprehensive scheme of electrification will require, the State power stations already constructed—Trollhättan, Porjus and Alfarkeby—will be able to supply important sections, especially when their capacity is further increased, as that of the Porjus power station will be; but the Stockholm-Gothenburg, the Katrineholm-Norrköping and the Järna-Nyköping line, in addition to the energy which can be derived from the Alfarkeby and the Trollhättan power stations, will probably require a power station in the Motala stream. Among those falls, which the State purchased some ten years ago for railway electrification purposes, were some valuable and well-positioned waterfalls in the Motala River; plans are being prepared for their exploitation, and negotiations are pending with some private waterfalls owners in the same stream which may lead to the State there obtaining an exceedingly well-situated hydro-electric power station of considerable capacity, which will prove of great value for central Sweden. In the Lagan the Swedish Crown owns the Laholm Fall, about 3 m. high, calculated to yield some 3300 hp., and the Karse Fall, higher up the river, with a calculated capacity of some 10,000 hp. Private enterprise has exploited several privately-owned falls in the same river, and it is part of this latter energy which the South Swedish Electric Company is now exporting to Denmark. It has been suggested that an advantageous cooperation between the projected State power stations in the Lagan and this company might be arranged, and the matter is likely to be proceeded with ere long.—London *Engineering*, March 10, 1916.

Electrophysics and Magnetism

Photoelectricity.—R. A. MILLIKAN.—A very extended and searching investigation showing that Einstein's photoelectric equation predicts in every case exactly the observed results. We are thus confronted by the astonishing situation that these facts were correctly and exactly predicted nine years ago by a form of quantum theory which has now been pretty generally abandoned. Planck's h has been photoelectrically determined with a precision of about 0.5 per cent and is found to have the value $h = 6.57 \times 10^{-27}$.—*Phys. Rev.*, March, 1916.

Righi's Magnetic Rays.—JAMES E. IVES.—The author first repeated Righi's experiments on the so-called magnetic rays, and his experimental results are in agreement with Righi's but by extending the research further he found that all the Righi's effects can be obtained without any magnetic field at all. For the circuit which the author is using the thing essential for the production of the Righi effect is the periodic interruption of the high-potential circuit on the anode side of the tube.—*Phys. Rev.*, March, 1916.

Radioactivity.—G. L. WENDT.—The author gives a revised table of radioactive constants embodying the results of the researches in the last few years.—*Phys. Rev.*, March, 1916.

Units, Measurements and Instruments

Measuring Very High Insulation Resistances of Cables.—F. FISCHER-HINNEN.—The direct determination of the insulation resistance of cables meets occasionally with difficulties when the galvanometer reflections are too small. In such cases the resistance may be calculated according to the method of Siemens from the drop of the discharge potential of the cable when charged to a certain potential, but it is necessary to know the capacity. The author shows how to eliminate the capacity by making two measurements. In the second measurement the first one is repeated but with a resistance in parallel with the electrometer.—*Elek. Zeit.*, Feb. 24, 1916.

X-Ray Spectrometer.—W. S. GORTON.—An account of an experimental investigation of an X-ray spectrometer employing mica as an analyzer.—*Phys. Rev.* March, 1916.

Miscellaneous

Rapid Reckoning Chart.—E. E. FOURNIER D'ALBE.—A rapid reckoning chart (Fig. 7) which may be used as a substitute for the slide rule. It consists of a diagram ruled on logarithmic paper, and it has the important advantage over the slide rule that it requires no setting. Ordinary multiplication is effected by taking the ordinate and abscissa corresponding to the two numbers to be multiplied and then passing from their point of intersection to the diagonal. The diagonal scale C also gives squares directly or square roots by the inverse

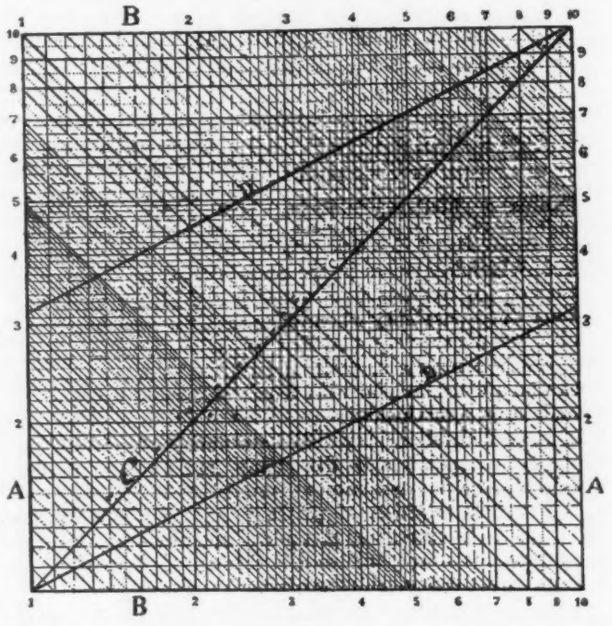


FIG. 7—RAPID-RECKONING CHART FOR USE AS SUBSTITUTE FOR SLIDE RULE

process. One of the most interesting features is the ease with which the cubes or cube roots can be obtained. All that is necessary is to find the number on the scale A, then proceed horizontally to scale D, and thence diagonally to scale C. It is obvious that a similar method is applicable for any root, by taking a line similar to the line marked D, at a suitable inclination, and this method would be particularly useful in the case of fractional indices.—London *Electrician*, March 3, 1916.

Ceylon.—An article giving statistical figures on the value of the imports of electrical and allied material into Ceylon during the year 1914.—London *Elec. Rev.*, March 10, 1916.

Readers' Views and Comments

Analytical Determination of Mean Effective Curren

To the Editor of the ELECTRICAL WORLD:

SIR: I have read the article entitled "Analytical Determination of Mean Effective Current," by Mr. W. D. Peaslee, which appeared on page 644 in your issue of March 18, 1916. The author of that article appears to be under the impression that this method is new and original with him. As a matter of fact, the method, in much more complete and generalized form, has been before the public for many years. It formed a part of my lectures on electric railway predeterminations as early as 1904 — twelve years ago. It was brought to the attention of the electrical world in general in a paper, in French, presented by me at the Electrical Congress at Turin, Italy, in September, 1911. The title of this paper, "Method of Determination of the Constant Current Producing the Same Heating Effect as a Variable Current," indicates clearly its object. A glance at the paper will readily show that Mr. Peaslee's article falls short of a comprehensive treatment of the subject from the standpoint of either the presentation of the theory or its practical applications.

Mr. Peaslee's ampere-input diagrams are only a few inches in length, and relate to heating effects lasting only a few minutes. The theory, as developed in my paper, and the examples used as illustrations, apply to heating effects of indefinitely long duration, such as, for instance, the heating produced in the electric motors of an electric locomotive or car during an entire run. Thus, the ampere-input diagrams shown in Figs. 3 and 7 of my paper were those for complete round-trip runs of an electric train in the New York subway. The ampere-time record for a "local" subway train (in Fig. 3 of my paper), making stops at all stations, and taking current no less than sixty distinct times during a round trip, lasting seventy-eight minutes, was 46 ft. in length. The ampere-time record for the "express" train (Fig. 7), making stops at all express stations in a round-trip run, lasting fifty-eight minutes, was 37 ft. in length, and shows thirty-two distinct current "intakes." These illustrative examples show what can be done by the method in its fully-developed form. There is no indication in Mr. Peaslee's article that he even contemplated the application or extension of the method to cases of the above-mentioned character and scope. Like Dr. J. A. Fleming of London, who, as stated in my paper, was the first to use the polar diagram (before 1896) for a similar purpose, Mr. Peaslee seems to have just missed the feature whereby the theory is generalized and the scope of its practical application is greatly extended. All this is set forth fully in my paper.

With respect to the practical applications of the method, my paper describes different ways of facilitating the process of transforming an ampere-diagram from rectangular Cartesian co-ordinates to polar co-ordinates, and, especially, it shows (in Figs. 5 and 8) how the operation of integrating one or any number of polar diagrams constituting a series, and the operation of obtaining therefrom the r.m.s. value (*i. e.*, the equivalent steady heating current) is greatly simplified and expedited by the use of the integraph, an instrument which, while performing an integration, draws a graph representing the definite integral for any area and for any portion of area intergrated by its use. The method set forth in the paper, whereby the r.m.s. value is obtained from the integrals of the polar diagrams, by the aid of the integrating instrument itself, without the necessity of any calculations (whether the instrument used be an integraph or a planimeter) is another feature of my paper presenting theoretical interest and practical value, as rendering possible further simplification of the work of applying the method, and insuring greater accuracy.

Shortly after the paper was presented I made another improvement in the practical application of the method, whereby still greater simplicity and precision were obtained. This was done by an apparatus devised by me whereby the ordinary ampere-time diagram, as drawn by a recording amperemeter, is transformed very quickly and very accurately into a polar diagram of any scale and of any desired vectorial angle. While the tracing point of the apparatus is following the outline of the ordinary ampere-time diagram, a tracing pen or pencil, operated by the apparatus, traces the corresponding polar diagram with the greatest precision. This apparatus not only draws the polar graphs much more quickly, but it does the work with far greater precision than is possible by the usual process, which consists in transferring the ordinates for a number of points by means of dividers, and then drawing in the intermediate portions by hand, guided by the eye only. In the majority of cases, as is well known, the actual current-input curves are far from being as smooth as those shown in Fig. 1 of Mr. Peaslee's article, but on the contrary, they are full of "notches" or "saw-teeth," which are caused by rapid fluctuations of the current. Sometimes these notches correspond to the steps of the controller, and sometimes, as in the case of motors operating rolling mills, they result from numerous sudden fluctuations in the load.

My apparatus reproduces very faithfully and precisely, in the polar diagrams, every irregularity or vibration in the Cartesian diagram from which it is obtained. Incidentally, it can also perform another interesting and important function. The ordinary ampere-recording instrument, as we know, gives a graph in which the ordinates are not rectilinear, but are curvilinear, in reality circular, being, in fact, ordinates of a circle whose radius is equal to the distance between the recording pen and the pivot on which the arm carrying the pen swings. My apparatus will automatically correct this circular distortion of the diagram, when it exists, and it can even be used for drawing a corrected Cartesian diagram with "straightened" ordinates of the same, or (if desired) of some other ordinate scale greater or less than the original.

The apparatus can draw the polargraph with equal facility from either form of Cartesian graph, that is, from one with circular ordinates or one with rectilinear ordinates. The apparatus has been used by me with great success in making polargraphs from ampere-input diagrams of electric motors used for operating rolling mills, and for other work in which the fluctuations were both numerous and large. The transformation of such Cartesian diagrams into polar diagrams, by the usual hand method, would be a tedious operation requiring great care, if errors are to be avoided. The polargraphs are drawn on separate sheets of paper. These sheets are then placed on a draughting table, in one or two rows, in the manner shown in Fig. 4 of my paper, and, by means of a planimeter or integraph, preferably the latter, the r.m.s. value is obtained from these polar diagrams, in the manner I described.

More recently I have had in mind another improvement, having for its object the further simplification of the process, namely, the development of an integrating mechanism whereby the r.m.s. value may be obtained directly from the ampere-time diagram, without the necessity of first drawing the polar diagrams and then integrating them afterwards. The theoretical study made of the question, and the practical experiments made, indicate that the desired result can be accomplished.

C. O. MAILLOUX.

New York City.

To the Editor of the ELECTRICAL WORLD:

SIR: In reference to my article in the March 18 issue of the ELECTRICAL WORLD entitled "Analytical Determination of Mean Effective Current" I developed this method in the spring of 1911 in the course of some analyses of non-sinusoidal waves. It was suggested by an abstract of some work by Dr. Fleming, in which the polar diagram of a sine wave was analyzed. It was only a short step from Dr. Fleming's analysis to the determination of the effective value of the wave.

It was not until 1914 that I found occasion to apply this method to the determination of effective values of current as described in the article, and this application was, of course, merely the utilization of the method I had developed in 1911. I was not aware that Dr. Mailloux or anyone else had developed this method until the matter was called to my attention after the appearance of my article, or I should certainly have given proper credit. Dr. Mailloux should be granted and I personally am glad to accord him an independent development previous to my own, and I take this opportunity to assure him that I knew nothing of his prior development before the publication of my article in the ELECTRICAL WORLD.

W. D. PEASLEE.

Corvallis, Ore.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

I. L. Meloon, president of the Twin State Gas & Electric Company, Dover, N. H., has resigned, effective May 1, and will remove to New York City. Mr. Meloon has been head of the company since June, 1906, having served also as general manager at Dover since June, 1913.

Frederick Sargent of the firm of Sargent & Lundy, Chicago, sailed from New Orleans, La., for Chile, S. A., on April 5. Mr. Sargent is making this trip in behalf of the Chile Exploration Company, a firm which is identified with the Guggenheim copper interests. He expects to return to Chicago in about two months.

George E. Scarfe, who has been superintendent of electric power in the Grass Valley-Nevada City (Cal.) district of the Pacific Gas & Electric Company for many years, recently tendered his resignation, which took effect on March 31. Mr. Scarfe is leaving the company to enter private practice as a consulting engineer.

W. S. Rathell, for many years connected with the utility properties of Waco, Tex., has resigned as manager for the Texas Power & Light Company at Waco, and as supervising engineer of the company's neighboring gas properties, to enter business at Houston, Tex. Mr. Rathell came to Waco in 1898 as manager of the Citizens Street Railway Company, and was in charge of the Waco street railway, electric light and gas interests for thirteen years. After the J. F. Strickland company purchased these properties, Mr. Rathell continued as manager until 1912, when the traction interests were taken over by the Southern Traction Company. Since that time he has been in charge of the local lighting property.

J. C. McLaughlin, who has been appointed manager of the commercial department of the Potomac Electric Power Company of Washington, D. C., succeeding the late E. S. Marlow, first entered the employ of the old United States Electric Light Company of Washington in 1888. Ten years later this company was absorbed by the Potomac company, and as the latter grew Mr. McLaughlin became successively bookkeeper, office clerk, salesman and assistant to Mr. Marlow.

J. C. MC LAUGHLIN

A. L. Baylor, manager of the engine department of The James Leffel & Company, Springfield, Ohio, has been appointed to the position of secretary of the company.

W. L. Bird, secretary and manager of the Kaministiquia Power Company, Fort William, Ont., has been elected president of the Fort William Board of Trade.

Addis M. Whitney has resigned from the treasureship of the Massachusetts Lighting Companies, Boston, his resignation to take effect on April 22. He has been treasurer of the company since its organization in 1903.

C. S. Harriman, who had charge of the contract department of the municipal lighting plant of Kansas City, Kan., for several years, is now connected with the Kansas City office of the Wagner Electric Company.

J. M. Fine, for the last eight years mechanical and electrical superintendent in the Northern Division of the United States Reclamation Service, is now in the electrical department of the Anaconda Copper Mining Company.

Oscar L. Gubelman of the firm of Knauth, Nachod & Kuhne has been elected a director of the Washington (D. C.) Railway & Electric Company, the Potomac Electric Power Company, the City & Suburban Railway of Washington an dthe Georgetown & Tenallytown Railway Company.

H. L. Reber, who has just been appointed president of the Kinloch Telephone Company, St. Louis, Mo., succeeding W. D. Orthwein, has been connected with utility work in various fields, including electric lighting and power plants and electric-railway systems. Mr. Reber was secretary and chief engineer of the Kinloch company when it was organized in 1899 and has been vice-president and general manager of the company since 1909.

R. B. Wolverton, United States radio inspector for the San Francisco district, has resigned, to become radio engineer of the Federal Telegraph Company. In his new position Mr. Wolverton will have charge, under L. F. Fuller, chief engineer, of the construction of the three wireless stations that the Federal company has contracted to erect for the Navy Department at San Diego, Pearl Harbor and Cavite. The Federal company is also preparing to install wireless stations at New York and Buenos Aires, which will give the first direct means of communication between Argentina and the United States. Mr. Wolverton, who is a Harvard graduate, took charge of the San Francisco office in November, 1912.

George G. Bowen has been appointed assistant sales manager of the Northwestern Electric Company of Portland, Ore., succeeding to the post made vacant through the resignation of W. H. P. Hill.

T. H. McElroy, for eleven years superintendent of the municipal light and water plant at Girard, Pa., has bought a controlling interest in and taken the management of the King City Electric & Manufacturing Co., King City, Mo.

Ezra B. Whitman of Baltimore, Md., has become a member of the firm of Norton & Bird, consulting engineers, Chicago, Ill., which will hereafter be known under the firm name of Norton, Bird & Whitman. In addition to their office at 111 West Monroe Street, Chicago, the firm will have an engineering office in the Munsey Building, Baltimore. Mr. Whitman is a graduate of Cornell, class of 1901, and has devoted much attention to sewerage and water supply work, serving the city of Baltimore as water engineer and president of its water board until 1914, when he resigned to enter general practice. William J. Norton of the firm was formerly first assistant secretary of the New York Public Service Commission, and Paul P. Bird, the other member of the firm, was formerly chief engineer for the Illinois Steel Company, smoke inspector for the city of Chicago, and later special power engineer for the Commonwealth Edison Company.

Arthur J. Selzer, sales manager of the Central Electric Company, Chicago, who was elected chairman of the Central Division of the Electrical Supply Jobbers' Association at the Detroit meeting, is a native of Evansville, Ind. His early experience in the electrical business was gained through five years' service as a wireman and a lineman. He also operated an electrical-contracting business in Vincennes, Ind., for two years. Later he spent two years as a salesman for the Varney Electric Supply Company at Indianapolis, Ind., and six years as salesman for the Electric Appliance Company of Chicago. In 1912 he was made Western sales manager for the Adams-Bagnall Electric Company at Cleveland, which position he retained until he became sales manager of the Central Electric Company of Chicago on Jan. 1, 1916.

A. J. SELZER

NEW APPARATUS AND APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Automatic Switching Apparatus to Provide Continuity of Service

Switching apparatus designed by C. W. Pendell of the Public Service Company of Northern Illinois and manufactured by the General Electric Company, Schenectady, N. Y., will, it is said, assist in procuring continuous service for customers who have more than one source of power available. For instance, a steam or an electric railway with alternating-current signaling circuits can be assured of continuous energy input to its signaling circuits through the use of this device with two or more sources of power. Isolated plants through the use of this switching apparatus can arrange for stand-by central-station service to be cut in automatically. Central-station customers fed by either of two lines can use the device to transfer their loads from one line to the other in case of line failure. Central stations operating transformer substations can use the device in places where direct-current solenoid-operated switches are now used, and thereby eliminate direct-current charging and battery equipment.

Essentially the mechanism consists of a single-phase repulsion-induction motor, a system of mechanical parts for transmitting the power of the motor to the switch-closing mechanism, provision for varying the time interval between the energizing of the motor and the closing of the switch, a low-voltage release to trip out the switch, a means to prevent the switch from closing should energy be restored to the line from the first source before the mechanism completes its operation.

Referring to the accompanying circuit diagram, it will be seen that the motor receives its power through the contacts of a low voltage relay, the coil of which is de-energized when power on the signal line or bus fails. The power of the motor is transmitted through a worm gear and pinion to the pawls which move the ratchet. One of the pawls works on an eccentric from the pinion shaft, and the other is fastened concentric to the shaft. For each revolution of the pinion shaft the eccentric pawl will move the ratchet through the angle subtended by one tooth, and the other pawl will hold the ratchet in position while the former is reaching forward for another tooth.

The movement from tooth to tooth consumes two seconds per tooth, and there are fifteen teeth. The ratchet may be set to start the motion on any tooth, so that the time interval from energizing of the motor to closing of the switch may be adjusted in two-second intervals from two seconds to thirty seconds.

The first movement of the ratchet closes the fingers of the auxiliary switch, relieving the relay contacts from carrying heavy current. The final movement of the ratchet simultaneously raises the weight of the low-voltage release and closes the main-line switch.

When the main-line switch closes, energy is restored

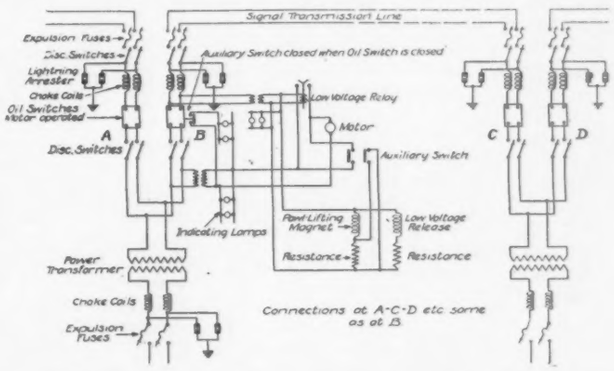
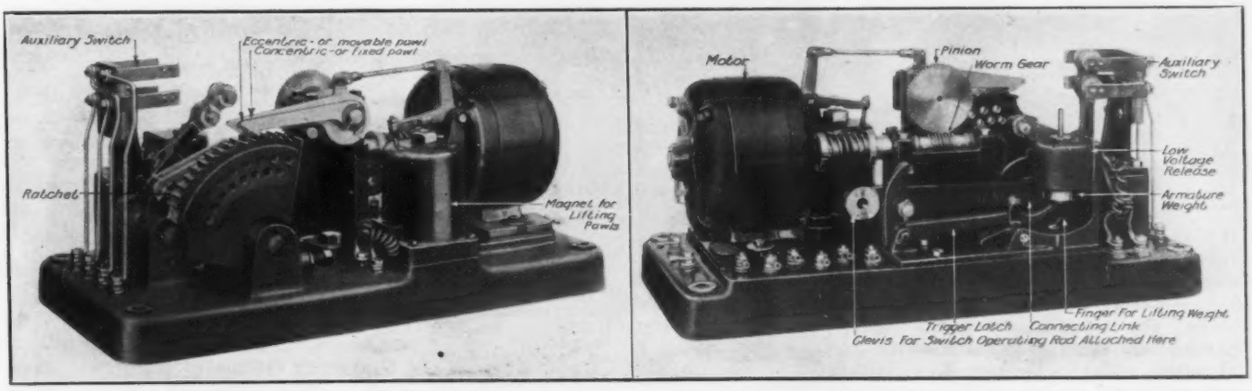


FIG. 3—WIRING DIAGRAM OF AUTOMATIC SWITCHING SYSTEM AS APPLIED TO SECTIONS OF A SIGNAL TRANSMISSION LINE

to the low-potential relay, and to the magnet which lifts the pawl. This allows the ratchet to return to its normal position and the auxiliary switch to open, but the main-line switch does not open because a connecting link attached to the operating rod is held by a trigger latch. The main-line switch may be tripped only by de-energizing the low-voltage release, the weighted plunger of which falls on the trigger latch, releasing the connecting link of the operating rod.

The restoration of service through one of these automatic switching equipments energizes the potential relay and pawl-lifting magnet of the mechanism con-



FIGS. 1 AND 2—VIEWS OF AUTOMATIC SWITCHING APPARATUS SHOWING RATCHET AND AUXILIARY SWITCH AND OPPOSITE SIDE OF DEVICE

trolling the other source of supply. This action, of course, immediately arrests further operation of that mechanism. All parts are then restored to normal and the switch is not closed.

The time element adjustments on the mechanisms controlling two power sources supplying a signal bus or other customer should be set to give one source the preference. If the mechanism controlling the normal source is set for ten seconds' delay and on the emergency or stand-by source set for thirty seconds, the normal source will be reconnected to the service before the emergency source is connected in case of a momentary interruption. If the interruption continues beyond the time equal to the difference in time setting of the mechanism, the emergency source will be connected to the service and the normal source will be blocked out.

Operation will be resumed from the normal source of supply when it is again available by tripping out the switch on the emergency supply through the action of a low-voltage relay energized from the normal source. No attendance is therefore necessary.

The equipments described and illustrated herewith are designed for single-phase operation, but they are applicable to polyphase circuits of any voltage as well.

Improved Automatic Door Switch

An improved device designated by the manufacturer, the Bryant Electric Company, Bridgeport, Conn., as the Perkins automatic door switch, has just been brought out for use on closet doors, hotel-room doors, etc. A feature of the switch, it is pointed out, is the short distance which the operating button projects beyond the face plate, this distance being only 11/32 in. This minimum projection of the operating button is said to be advantageous, since a door does not have to be opened so much to permit the complete operation of the switch. Two screws hold the plate in position. The operating mechanism of the switch has been simplified and the parts thereof made ample and strong. The commutator is of the knife-blade type, and is insulated by fiber blocks which prevent overheating and, it is

AUTOMATIC DOOR SWITCH

declared, eliminate risk of damage or carbonization. Switches of the type described can be provided for closing the circuit when the door is either opened or closed.

Improved Mechanical Stoker

The "Ko-Shovel" stoking machine, as it is called, shown herewith, is designed to inject coal in a furnace in small charges with the fire doors closed. Owing to the fact that the charges are small and frequent and that the fine dust particles of coal can be completely burned before they reach the grate, the stoker, the manufacturer points out, is particularly efficient and economical in operation. The stoker may be installed either directly in the upper portion of the fire-door opening or immediately above the door in the boiler front. The

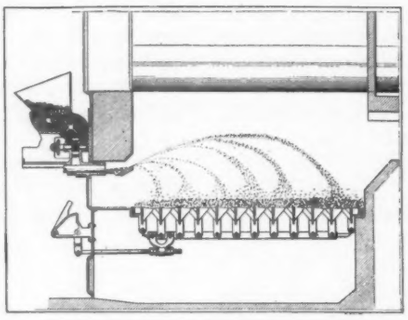


FIG. 1—SECTIONAL VIEW SHOWING METHOD OF FIRING FUEL

entering chute and plunger require a space only 5 in. deep and when installed in the fire-door opening, a new door is usually provided. The installation of the machine does not prevent or interfere with firing by hand or in cleaning the fire through the fire doors.

The method of operation is simple. Coal is fed into a hopper having sufficient capacity to run the boiler for about one hour, the amount fed to the boiler being determined by the speed of the mechanism, which may be automatically controlled. From the hopper the coal passes through a crusher, which reduces the larger lumps to a size suitable for firing, the crushed coal dropping into the plunger chamber. At intervals, which are determined by the speed at which the stoker is operated, the plunger (which is actuated by two heavy springs under tension) ejects the coal, which is uniformly distributed over the fire grate by the action of a water-cooled, peculiarly shaped deflector plate over which it passes. The machine is designed to handle any grade of fuel up to 1.5-in. bar screening or down to No. 5 washed or unwashed coal. It may be either electrically driven or steam driven, as desired. About 0.5 lb. of fuel is fired at each stroke of the plunger and the total quantity is determined by the speed of the machine. Automatic regulation of boiler pressure can be secured by an automatic valve, controlling the steam entrance to the driving engine. Automatic regulation for driving the machines by motor is also obtained by boiler-steam-pressure control.

George A. Kohout & Company, Chicago, Ill., are exclusive distributors of this machine.

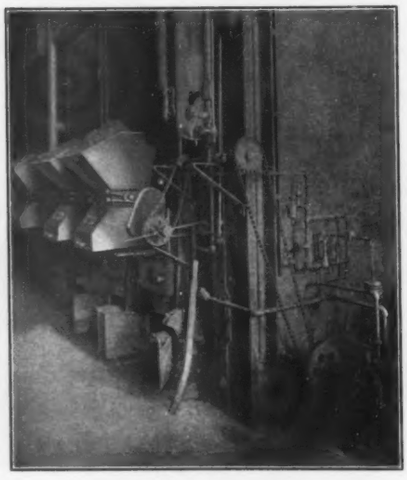


FIG. 2—BATTERY OF MECHANICAL STOKERS

Oil Engines

Internal-combustion engines of the two-stroke-cycle types designed to operate on from 0.82 lb. to 1 lb. of crude oil or fuel oil per kilowatt-hour from one-half load to full load are shown herewith. These engines are of the Skandia (Swedish) make and are being placed on the market by the Marine Oil Engine Company, 30 Church Street, New York, which company will shortly begin the manufacture of them in this country. In Fig. 1 is shown a single-cylinder engine which is directly connected to a generator. Both generator and engine are mounted on the same base, as shown. This outfit is built with ratings of from 5 hp. to 30 hp. and is adapted for use as a generator set for either industrial plants or auxiliary lighting sets on board ships.

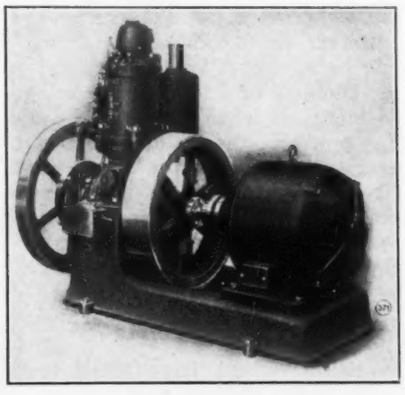


FIG. 1—SINGLE-CYLINDER ENGINE DIRECTLY CONNECTED TO GENERATOR

Multi-cylinder engines have also been developed, and they can be utilized for either belt-driving purposes in industrial plants or for direct connection to

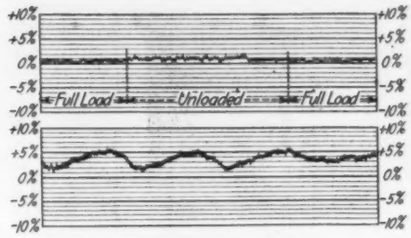
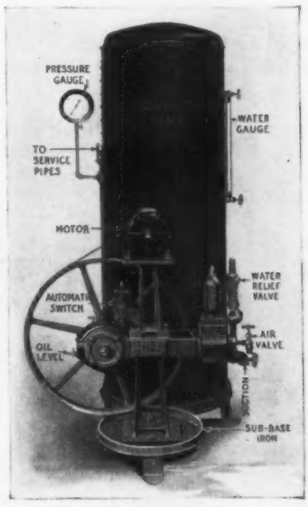


FIG. 2—REGULATION CURVES

either direct-current or alternating-current generators. In Fig. 2 are shown two regulation curves, one being for two-cylinder and four-cylinder engines directly connected to alternating-current generators, and the other for single-cylinder engines for small direct-current plants.

Electric Pump Outfit for Domestic Service

In the accompanying illustration is shown a complete motor-driven pumping outfit designed especially for use in residences where city water service is not available. The pump itself is of the horizontal double-acting type and forces the water into the tank shown, which is 20 in. in diameter and 5 ft. high. When the pressure in the tank reaches the desired maximum the motor and the pump are automatically stopped until the amount of water drawn off lowers the pressure to the point at which the automatic switch is set—

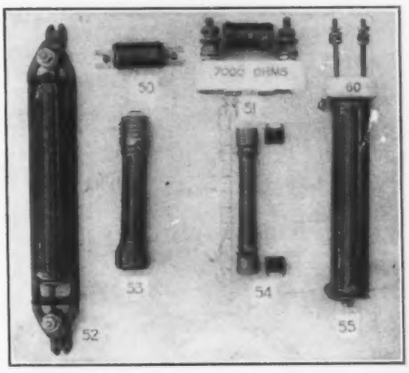


MOTOR-DRIVEN DOMESTIC PUMPING OUTFIT

when the motor and pump again start and replenish the tank. To prevent the tank getting "water-logged" (or filled with water) an air valve is provided which opens and allows the pump to force more air into the tank. Usually the tank is about two-thirds full of water and one-third full of air. A water relief valve is also provided as a safeguard to prevent excessive pressure in case the automatic switch fails to work for any reason. The motor is connected to the pump by means of a flywheel and belt, as shown. The air valve which forms part of the equipment is a regulating check valve which, when opened, allows some air to be drawn into one end of the cylinder and then forced with water into the tank, where it at once takes its place in the upper part of the tank, thus thoroughly aerating the water. The pump is driven by a 1/6-hp. motor and has a capacity of 180 gal. per hour. The tank has a capacity of 80 gal. The suction and discharge pumps are 0.75 in. in size. The outfit occupies a floor space 33 in. by 39 in. and is 5 ft. 6 in. high. The pump operates at a maximum pressure of 50 lb. The total weight is 600 lb. The electric pumping outfit described is being placed on the market by the Hill Pump Company, Anderson, Ind.

Signal-Resistance Units

Compact units of high-resistance and moderate energy-carrying capacity have recently been brought out by



RESISTANCE UNITS FOR SIGNAL, TELEGRAPH AND TELEPHONE APPARATUS

the Ward Leonard Electric Company, Bronxville, N. Y., for use with signal, telephone or telegraph apparatus. In the accompanying illustrations are shown units, which use wire having practically a zero temperature coefficient, according to the manufacturer, wound on porcelain tubes and covered with a vitreous enamel. The resistance wire is embedded in a material which will expand and contract at the same rate, it is pointed out, as the resistance itself within the limits of usage, thus preventing the adjacent turns from closing together and short-circuiting and, therefore, preventing a change in the resistance of the unit which might cause a burn-out in the circuit. The vitreous enamel in which the wire is embedded and by which it is entirely covered protects the wire from the atmosphere. As the entire wire is hermetically sealed, it cannot deteriorate, owing to the action of moisture or corrosive elements. The coating of enamel over the wire is so thin and the enamel is so good a conductor of heat, it is declared, that the heat generated is dissipated very rapidly, because the radiating surface is practically increased from that of the fine wire to that of the porcelain tube. The units are of sturdy construction, small, non-abrasive, rustproof, waterproof, fireproof and dustproof. The connection between the resistance wire and the terminal leads is embedded in the vitreous enamel, which preserves the joint against any depreciation. In the illustration are shown units arranged to be screwed into lamp sockets and also units equipped with ferrule ends for fuse-clip mounting, and angle ends for mounting in standard signal blocks, and especially adapted types for telephone and telegraph service. Any of the units shown can be provided with resistance as high as 10,000 ohms on one layer of wire. All of the units are so designed that they can be readily mounted, as can be seen in the accompanying illustrations.

Automatic Feeding Device for Electric Shoe Embosser

Electrically heated embossing and stamping machines for use in shoe factories are supplanting gas-heated apparatus. A recent invention is an automatic feed used in connection with the Simplex electric embosser, manufactured by the Boston (Mass.) Last Company. With this machine the operator can use both hands in controlling the stock being embossed, the embossing leaf, in strip form contained in a roll, being fed through the machine automatically. An adjustable rack and spur

ELECTRIC EMBOSSER WITH AUTOMATIC FEED

gear allows the leaf to be advanced the desired length at each printing, change of spacing being obtained by unlocking a nut on the rocker arm and adjusting the lever according to the width of the stamp. The machine is so timed as to feed only when the stamp is raised clear of the material.

Electric Vibrators for Foundry Use

Electrically-operated vibrators, which are designed for use in rapping patterns and which are said to be superior to air vibrators developed for the same purpose, are being placed on the market by the Magnetic Manufacturing Company, Milwaukee, Wis. In Fig. 1 is shown an end view of a Type A vibrator, as it is called, with switch attached. The device is connected to the power circuit by a three-wire plug and receptacle mounted on the outlet-box cover. This vibrator is especially well adapted for use on benches, squeezers, and heavy molding machines. A hand switch is provided when the device is employed on roll-over machines or where the workmen wish to operate it on a remote or moving part of the machine. A knee switch may be used in place of the hand switch if desired.

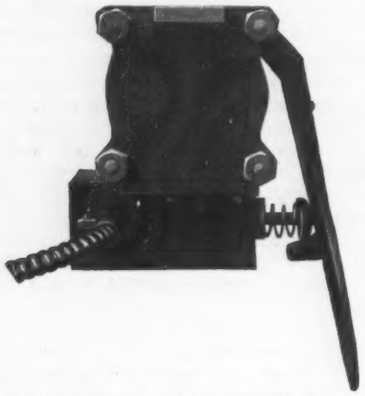


FIG. 1—END VIEW OF PATTERN VIBRATOR

In Fig. 2 is illustrated a Type P vibrator attached to a pattern plate, showing knee switch in place. This vibrator is equipped with 5 ft. of wired flexible-steel conduit.

The vibrators are inclosed in steel housing. They are compact and consist of a metal plunger having hardened ends actuated by solenoid coils incased in a smooth cylindrical steel housing, the coils causing the plunger to work first against the hardened metal anvil in one end and then against an anvil on the other end. The plunger is maintained centrally in the solenoid tube by magnetic force, thus preventing friction and therefore requiring no lubrication.

FIG. 2—ELECTRIC VIBRATOR ATTACHED TO PATTERN PLATE

The vibrators are operated on direct current. For use where only alternating current is available, the above-named concern has brought out a four-wire converter set.

Distributing Panel for Dental-Office Service

For the control of various electrical and compressed-air circuits in dental offices the Ritter Dental Manufacturing Company, Rochester, N. Y., has brought out the "Columbia" distributing panel, as it is called, shown herewith. At the top of the apparatus are placed three pressure gages as shown. No electrical connection is made in the front of the panel. The fuses are covered with caps made of insulating material. The switches are of the push-and-pull type. Large switch buttons on each side of the clock shown in the middle of the board are connected to the pilot-lamp circuit. The switch on the left is designated as the master switch, and opens and closes the main circuit, which supplies energy to the panel. The other switch controls the instrument and instrument-holder circuits. Along each side of the panel are three switches, which control six full-supply-voltage outlets. These switches are controlled by the master switch, and in turn control the outlets for attaching the dental engine, compressor, fan, lamps, etc. On the back of the clock is an indicating dial which revolves once in twenty-four hours, and the mechanism is so arranged that the energy can be shut off at any time desired. Use is made of four regulators which individually control four outlets on the instrument holder. Each regulator has its indicator and separate graduated scale, and upon the latter appears a name which corresponds with a similar name on one of the instrument-holder outlets. The two smaller regulators are placed on top of the two larger regulators for economy of space, but have no connection whatever. The regulators in the combination of large and small devices turn in opposite directions to prevent confusion. The low-voltage outlets are designed for alternating current. Where only direct current is available the Ritter company has brought out a rotary converter which is designed to change the direct current to alternating current suitable for the low-voltage instrument. The electrical portion of the panel is mounted on a separate iron frame hinged to the main frame, as shown in Fig. 1. At the top is a combination knife switch which opens and closes the circuit as the face of the panel is swung open or closed.

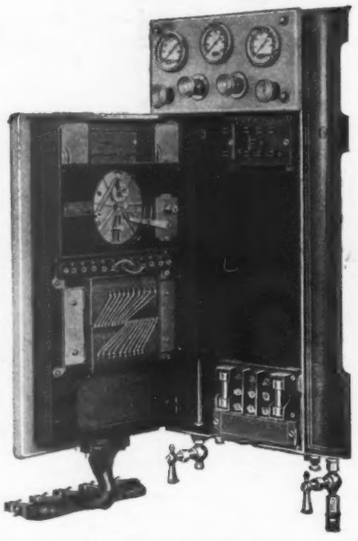


FIG. 1—ELECTRICAL PANEL SWUNG OPEN

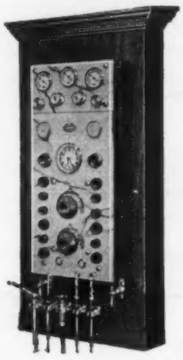


FIG. 2—OUTSIDE VIEW OF DISTRIBUTING PANEL

Metal Molding Fittings

"Stewart" metal molding fittings for single-branch and double-branch circuits have recently been placed on the market by Edwards & Company, 140th Street and Exterior Street, New York City. The fittings consist of three pieces—the steel base plate, the connecting block and the porcelain cover. In installing the fitting it is not necessary to cut the base of the molding to make a branch or to cut the wire. Soldering and splicing are also unnecessary. The porcelain cover is keyed so that it will always be in position, and the screw that holds the cap will pick up the thread, it is declared, without any trouble. The illustration shows double-branch fitting with cover removed, showing three wires in the main circuit.

DOUBLE-BRANCH FITTING WITH COVER REMOVED

Electric Irons

The Model A electric iron, as it is called, shown in Fig. 1, is double pointed, permitting operation either forward or backward as desired. It is provided

FIG. 1—DOUBLE-POINTED IRON

with a heat reservoir which, according to the manufacturer, the Below Company, Chicago, Ill., stores the heat for use after the current has been switched off. A steel cord holder is provided which keeps the cord out of the operator's way and prevents abrasion. The iron is equipped with 6 ft. of connecting cord and insulated stand, as shown. It weighs 6.5 lb.

In Fig. 2 is shown a 6-lb. Model D iron of low price which is equipped with steel-blued sole plate, which heat cannot discolor, it is claimed. The upper portion of the iron is highly nickeled. The iron is also equipped with 6 ft. of cord and insulated stand.

FIG. 2—SIX-POUND ELECTRIC IRON

Automatic Switch for Charging Panels

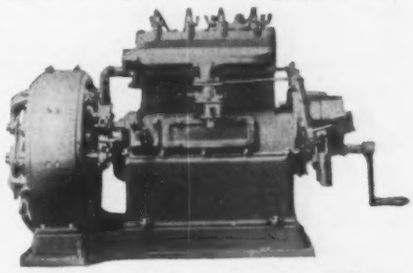
Motor-generator sets are now being extensively used in garages and service stations for charging automobile ignition and lighting batteries. In cases where the switchboards employed with these sets are not equipped with a reverse-current circuit breaker or other device for protecting the battery against failure of the line current and to prevent the battery from discharging back into the generator, the switch shown herewith has been developed by the Hartman Electrical Manufacturing Company, Mansfield, Ohio. It is a modification of the company's Type B cut-in and cut-out switch designed particularly for use with small generating plants. The modification consists in inserting resistance in the circuit with the shunt coil of the switch, with means of varying the resistance according to the number of batteries to be charged. This is accomplished by means of a small button and pointer shown in the cut. This pointer is turned to 1, 2, 3 or 4, depending on the number of 6-volt batteries it is desired to charge in series. Of course, the number of batteries which can be charged in multiple is limited only by the capacity of the motor-generator set. The equivalent in 12-volt batteries can also be charged, as for example, if it is desired to charge two 12-volt batteries in series, the pointer is turned to 4. At any of these settings the switch will open on a very

AUTOMATIC SWITCH FOR AUTOMOBILE CHARGING SETS

small reverse current. In addition to performing the functions of a reverse-current circuit breaker, the switch will also automatically cut-in or close the circuit when normal conditions are restored. It does this the instant the generator voltage is high enough to charge the batteries which are in circuit. The moving contact is in the form of a laminated brush, made up of thin gage copper and slotted to give it additional flexibility. The brush is protected by an auxiliary or arcing contact.

Motion-Picture Lighting Set

The 4-kw. self-contained generator set shown herewith is especially well adapted for moving-picture work and has been developed by the Universal Motor Company, Oshkosh, Wis. It operates at a pressure of from 60 volts to 110 volts, and is designed to take care of an overload of 20 per cent above that required for the picture machine, permitting the use of electric fans or from twenty-five to fifty incandescent lamps in addition to the machine. The generator is directly connected to a four-cylinder, four-stroke-cycle vertical engine with inclosed throttling governor, magneto and automatic oiling device. The oiling is said to be complete and requires no attention outside of occasionally filling the base and noting the supply by means of the oil gage. A good supply for continuous service is provided by 1 gal. or 1.5 gal. of oil poured into the base. The set runs so smoothly and quietly, it is declared, that no flicker is noticeable on the lamps, whether only one lamp is used or the full number which the machine is designed to operate are employed. The

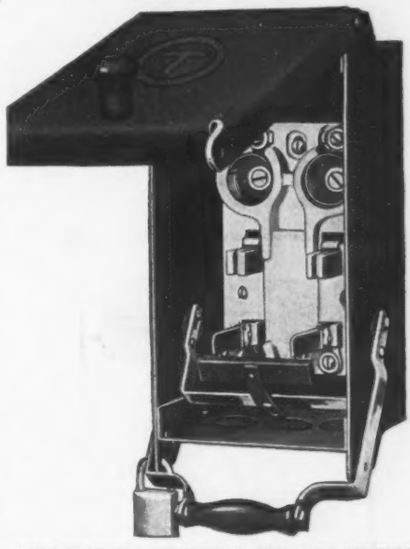


MOTION-PICTURE GENERATING OUTFIT

governor is sensitive in its action, it is pointed out, holding the speed uniform at all loads. Because of its smooth operation, it is possible to use the generator set without a switchboard, connecting the generator directly on the line, without storage batteries. A switchboard can be employed, however, if desired. The speed of the engine can be set at any point, from 600 to 1200 r.p.m.

Inclosed Combination Switch

In the accompanying illustration is shown a No. 701 combination switch, as it is called, inclosed in a steel box. The switch is externally operated and cannot be connected without the cover being closed and held in closed position by the handle, which closes the switch. The box cannot be opened without disconnecting the switch. It can be locked



COMBINATION SWITCH WITH BOX OPENED

closed, and when opened can either be locked or wires run in sealing. The switch mechanism is of the quick-break type. The inside measurements of the box are 8 in. long by 4.5 in. wide by 3.875 in. deep. Three knock-outs are provided in each end of the box. The switch is rated at 30 amp. at 125 volts. It is made by the Trumbull Electric Manufacturing Company, Plainville, Conn.

NEWS OF THE INDUSTRY

A Review of Activities in the Electrical Manufacturing, Selling and Central-Station Fields

January Electrical Exports

Exports of electrical goods of American manufacture for the month of January, 1916, according to the monthly summary by the Bureau of Foreign and Domestic Commerce, amounted to $2,320,822. This is an increase over January, 1915, of more than $500,000 or 31 per cent. The principal increases occurred in the exports of the insulated wire and cable, the January, 1916, exports of which were valued at $265,622 as against $83,728 in January, 1915; metal filament lamps, the January, 1916, exports of which were valued at $109,720 as against $38,504 in January, 1915; and motors, the value of which exports increased from $205,140 in January, 1915, to $389,380 in January, 1916.

Also there was a considerable decrease in the export of certain goods. In January, 1915, the value of the exports of dynamos and generators was $309,868, and in January, 1916, but $56,983. The export of telegraph instruments, including wireless apparatus, decreased from $17,326 in January, 1915, to $5,802 in January, 1916. The export of telephones decreased from $184,556 in January, 1915, to $69,050 in the opening month of 1916. There were also slight decreases in the export of electric fans and of transformers, together somewhat more than $2,000.

	January		Seven Months Ended January	
Articles Exported	1915	1916	1915	1916
Batteries	$100,946	$115,354	$409,951	$822,212
Dynamos or generators	309,868	56,983	1,246,572	852,748
Fans	17,221	16,010	88,700	203,829
Insulated wire and cables	83,728	265,622	669,740	1,701,393
Interior wiring supplies, etc., including fixtures	72,104	87,611	350,424	495,471
Arc lamps	759	1,203	16,964	10,407
Carbon filament lamps	5,802	14,667	37,238	102,995
Metal filament lamps	38,504	109,720	221,109	684,364
Meters and other measuring instruments	40,556	75,352	197,942	448,951
Motors	205,140	389,380	1,639,132	2,283,042
Telegraph instruments (including wireless apparatus)	17,326	5,802	44,480	93,575
Telephones	184,556	69,050	803,176	448,932
Transformers	57,122	55,708	408,752	520,535
All other	640,306	1,058,360	4,387,674	6,970,115
Total	$1,773,938	$2,320,822	$10,521,854	$15,638,569

For the seven months ended January, 1916, the exports of electrical goods amounted to $15,638,569, as against $10,521,854 for the seven months ended January, 1915, and $15,793,291 for the seven months ended January, 1914. During the seven months ended January, 1916, there was in comparison with a like period ended January, 1915, as will be noted in the accompanying table, a decrease of some $400,000 in the export of generators, a decrease of more than $6,000 in the export of arc lamps, and a decrease of more than $400,000 in the export of telephones. Aside from an increase of over $2,500,000 in the export of electrical goods of a miscellaneous character, the principal increases in the export of electrical goods during the period July-January, 1916, over July-January, 1915, were in batteries, $400,000, approximately; insulated wire and cable more than $1,000,000; metal filament lamps over $450,000, and motors approximately $650,000.

Public Service Commission News

Vermont Commission

The Vermont Public Service Commission has issued an order approving the purchase of the Waterbury Light & Power Company by the Montpelier & Barre Light & Power Company. The Waterbury company has been operated by the Tenney central station interests of Boston for the past two years under a lease with option to purchase. The system has one steam auxiliary and two hydroelectric generating plants of 1300 kw. total rating tied into the Montpelier-Barre system by a 13,000-volt line, also under Tenney management. It centers at Waterbury, twelve miles from Montpelier, and also serves Westfield, Waitesfield, Moretown and Northfield.

The commission has authorized the Eastern Vermont Public Utilities Corporation to do business within the state. Water rights are to be developed in the counties of Caledonia and Orange, and an extensive electrical distribution system will be built in Danville, Peacham, Barnet, Ryegate, Groton, Stannard, Walden, Cabot, Woodbury, Newbury, Topsham, Orange, Corinth, Washington, Chelsea, Tunbridge, Randolph, Bethel and Royalston, with principal office at Hardwick.

California Commission

In denying the motion to dismiss the petition of the city of Palo Alto for an order fixing the compensation to be paid the Palo Alto Gas Company for its property, the California Commission held that the provision of a gas franchise giving a town the option to purchase at a price to be determined by the arbitrators does not prevent acquisition by eminent domain, since the provision is not a contract, and assuming that it were, it would make no difference since a town cannot grant away its right to exercise the power of eminent domain.

The Railroad Commission dismissed the complaint against the United Light, Fuel & Power Company alleging the maintenance of a discriminatory electric rate, stating that it is obviously impossible to show that one utility is discriminating because another utility is supplying the same commodity at a different rate in another community.

Nebraska Commission

Authority has been granted the Omaha & Lincoln Railway & Light Company to include in securities issued for money expended an allowance for the increased cost of building a transmission line in the winter. It was shown that the immediate construction caused the company's earnings to be at once benefited, besides enabling the company to be the first to enter a field where competition was threatened. The commission held that the results justified the conclusion that the company exercised reasonable business judgment in building the line at that time, although its cost was materially greater than it would have been had the company waited until winter was over. The commission would not permit the company to capitalize extra construction expense for the specific purpose of securing immediate revenue and at the same time capitalize interest for the full period of construction, particularly that portion af-

ter it commenced to receive revenue. An allowance of 5 per cent on the cost of the property for stores and supplies was approved.

Massachusetts Commission

The Gas and Electric Light Commission has issued an order practically halving the value of a stock issue asked by the Northampton Gas Company, authorizing the issue of 905 shares of stock at $28.75 per share, whereas the company desired to issue 2180 shares at $25, the par value. In reviewing the case the board gives among its reasons for cutting down the amount petitioned for, that profits made by the Light, Heat & Power Corporation, an organization controlled by the Massachusetts Lighting Companies, owner of the gas company, upon real estate transactions with affiliated properties do not permit full capitalization. The gas company paid $24,756 to the Light, Heat & Power Company for certain property. The commission was unwilling to allow the issuance of stock against the whole of this indebtedness, because $6,906 of the amount was profit to the Light, Heat & Power Corporation. Other inter-company transactions led the board further to reduce the issue.

Illinois Commission

The Illinois Public Utilities Commission has handed down a decision reducing the price of gas supplied to the city of Springfield by the Springfield Gas & Electric Company after a hearing lasting over a period of two years. In all five separate valuations of the company's gas property were submitted, two by the city, two by the company and one by the commission's engineer, no two of which used identical theories.

In connection with the determination of a fair allowance to cover overhead expenses consideration was given by the commission to the general characteristics of the property and to the efficiency of its operation as a public utility so as to obtain a measure of the skill and judgment exerted during construction. On this point the commission said: "Overhead expenses represent, for the most part, skill, judgment and ingenuity preparatory to and during the construction period, and it is reasonable to presume that such skill, judgment and ingenuity were paid for in proportion to value received, and would be so paid for if the property were reproduced. This is particularly true in regard to engineering and supervision, and it should be borne in mind that, if engineering and supervision fees are to be allowed at a rate for which first-class professional services are to be procured, the evidence of eminent professional service would be reflected in the existing property." A claim for engineering amounting to 5 per cent of the total tangible property was held to be a very remunerative fee for engineering or supervision.

Working capital, it was held, should represent a sum which is sufficient and ample under normal conditions to meet and carry the obligations incurred and bills payable prior to a reimbursement of same from bills receivable.

In regard to "going value," the commission in effect held that the only element of "going value" which may be entitled to be included in valuation for rate-making purposes is that defined to mean the net unrecompensed deficits sustained by a utility when operating at a loss during the very early years of its existence. Even this theory is not wholly adopted by the commission, in view of the fact that such inclusion in a valuation may have a tendency to capitalize early mismanagement and extravagance. In any event, the commission insists that any claim for "going value" must be supported by proof of its existence, and that a claimant should not be permitted to guess at what that value may be. The commission is of the further opinion that, when utility property is appraised by an expert for rate-making purposes, the appraiser, either consciously or unconsciously, values the property as a living entity and going concern.

The utility which is excellently managed, progressive in development, alive to the public requirements, aggressive in securing new business, economical in operation, courteous to customers and fundamentally honest in all transactions, in the opinion of the commission, should receive greater consideration in the fixing of a fair rate of returns than should a utility of which the reverse is true. The commission found 7 per cent to be a fair rate of return in the present case.

In fixing upon a reasonable and equitable annual depreciation to cover future operating conditions, the commission stated that it leaned toward a simple straight line method that provides for the setting aside of equal yearly installments which ultimately accumulate into a depreciation fund. This fund, it was held, should be drawn upon only for renewals and replacements of existing unamortized property, and should remain intact in an individual and separate account, except for such withdrawals as are made necessary to reimburse the investors for future depreciation only. The fund should be subject to an annual audit by the commission's accountants, and should receive full credit for all interest which it may earn.

New Jersey Commission

In approving a $370,000 issue of capital stock by the Ocean County Electric Company, the New Jersey Board of Public Utility Commissioners laid down the rule that projects involving the utilizing of natural resources should be capitalized so that the public, as well as the promoters, will derive advantage therefrom.

The proceeds of the capital stock issued are to be devoted to the construction and development of a hydroelectric plant on the Toms River, a short distance above the town of that name, and a transmission line is to be built connecting the plant with the Toms River Electric Company. The plans have already met with approval of the State Water Supply Commission.

Summarizing the rule applied in fixing the value of the water power as an element in determining the capitalization of the company the board said:

"With reference to the value of the water power, we are confronted with the fact that, although several attempts have been made to develop the water power on the river in question, up to the present time none of these attempts has been successful. The board is inclined to be conservative in allowing value for the water power. It is not unusual to arrive at the value of water powers by comparing the operating cost of steam plants and hydroelectric plants, and in this way arrive at the saving in the cost of production in one plant as compared with the other. The amount of savings capitalized on a reasonable basis would represent the maximum value which the water power could have, or, in other words, would represent the maximum basis which would justify the development of a water power.

"Projects, such as this, which involve the harnessing of natural resources, should be capitalized so that the public secures advantage, and the promoters should be allowed such sum for the collocation of the water power as reasonably represents a return for vision and enterprise. Of such values, so ascertained, the promoters cannot alone have the advantage. The general public must be permitted to share in it. Any other rule would result in imposing upon the public the necessity of paying rates upon the cost of the more expensive method of power development, though the less costly method was employed."

Fort Worth Contractors May Be Taxed $150 Per Year.—An ordinance providing a tax of approximately $150 a year for all electrical contractors will soon be proposed to the City Commission by Light Commissioner Jamieson. This will do away with the present inspection fee system.

1916 Edition of Chicago Electrical Code.—The 1916 edition of the rules and regulations of the department of gas and electricity of the city of Chicago governing the installation of wires and apparatus for electric light, heat and power and for the construction and installation of electric signs and displays, has been issued.

Government to Study Alaska's Water Power.—The United States Geological Survey will have twelve parties in Alaska during the coming season to study the territory's natural resources. Besides surveys of the mineral conditions of Alaska and work in connection with the government railroad, the plans include an investigation of the water power of southeastern Alaska.

Worcester Plant to Increase Its Capacity.—The Webster Street station of the Worcester (Mass.) Electric Light Company will shortly be enlarged by the addition of a 20,000-kw. Westinghouse turbine-generator. An extension of the plant approximately 68 ft. by 78 ft. in plan will be required. The company's business is increasing rapidly and the new unit will virtually double the capacity of the present installation.

New Schedule For Rates in Kansas City Filed.—The Kansas City Light & Power Company is filing with the Public Service Commission of Missouri new schedules of rates under which there is a general equalization of rates for industrial users. The orders of Judge Hook for the separation of the companies and the reorganization involved the annulment of all the power contracts of the Kansas City Electric Light Company, the court taking the ground that the Public Service Commission would have instant supervision of the rates of the new company coming in, and should be given the opportunity for a general supervision of them at this time.

Bill Introduced to Create Niagara Hydroelectric Power Commission.—A bill has been introduced into the Assembly of New York State creating the Niagara-Hydroelectric Power Commission to consist of three members appointed by the Governor with the consent of the Senate of the State. It is proposed that the commission shall construct, operate and maintain a State power house on the reservation at Niagara Falls to generate and distribute electrical energy at cost to the communities of western New York. In fixing rates it is proposed that the commission may apportion the original cost of construction among contracting parties without control by the Public Service Commission and may provide for a gradual return to the State of the original outlay. The bill provides for an appropriation of $650,000, of which not more than $275,000 is to be available this year.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

City to Give Up Wiring and Electrical Merchandizing Business. — The Board of Public Utilities of the city of Riverside, Cal., which operates a municipal electric light plant, in response to the request of the business men's association has voted to go out of the house-wiring business except in answering emergency calls and to discontinue entirely the sale of electrical appliances providing the private retail merchants buy out for cash the present stock on hand in the department's storeroom.

New Hydroelectric Plant for Maine. —Preliminary work has been begun by the Cumberland County Power & Light Company, Portland, Me., in connection with the erection of a 20,000-hp. hydroelectric station at Hiram Falls, on the Saco River. About $500,000 will be expended initially upon a dam, station building and machinery aggregating 6000 hp. in capacity. A 66-ft. head will be developed, and it is estimated that the construction work will take six months. The generating station will be located on the Baldwin side of the river. The power developed will be utilized in Portland and other centers on the Cumberland company's system.

Jovians and Society for Electrical Development to Co-operate.—J. M. Wakeman, general manager of the Society for Electrical Development, and one of the early members of the Jovian Order, and a Past Supreme Apollo, has been appointed by Jupiter Thomas A. Wynne a Statesman-at-Large of the Jovian Order. In appointing Mr. Wakeman to this rank in the order Jupiter Wynne writes that "the appointment is made with the feeling that the Society for Electrical Development and the Jovian Order will be in close touch and will co-operate with one another to the fullest extent."

St. Louis to Have Large, New Generating Plant.—The Cupples Station Light, Heat & Power Company intends to increase its capital stock shortly with a view to the erection of a large generating plant on the river front, the construction of which will allow the company to enter into active competition in the local lighting field. H. Wurdack, president of the company, says that this decision followed the city counselor's opinion to the effect that electric companies which had qualified under the Keyes ordinance would be allowed to put wires underground outside the underground district at the discretion of the Board of Public Service, as was reported in the issue of the Electrical World of March 25.

Property Owners Assessed for Street Lighting.—The city manager of Sandusky, Ohio, has recommended to the city commission that the cost of street lighting, instead of being paid out of the general funds of the city, be assessed against the property owners.

Rochester Company Gives Employees Business Instruction.—The Rochester Railway & Light Company has launched an educational program in which the officials of the company will give half-hour talks to the employees daily on theoretical and practical fundamentals of the business.

Construction of Los Angeles Municipal Power Plant Started.—Work has been started on the erection of a municipal power plant for the water department of the city of Los Angeles on the city's property at St. John and Holly Streets. The building, which is to cost $60,000, will be three stories high, and is expected to be completed around Sept. 1.

Competition for Design of America's Electrical Week Poster.—The Society for Electrical Development has inaugurated a competition for the design of the official poster to be used in promoting America's Electrical Week. The competition will close on June 1. Besides setting up $2,000 in prizes the society's poster committee will act as an agency in disposing of many of the best originals.

New Jersey Utilities Finance Correspondence School Courses for Employees.—The Commonwealth Electric Company and the Commonwealth Water Company of Summit, N. J., and the Lakewood & Coast Electric Company and Lakewood Water Company of Lakewood, N. J., have offered their employees an opportunity to take correspondence school courses for which the company, under certain considerations, will pay a percentage of the cost. The student selects the courses, but they must be approved by the company, which will pay 50 per cent of the full price of the courses provided the student attains an average of 90 per cent, and for each additional per cent attained by the student the company will pay an extra 2 per cent.

Commissioners Opposed to Amalgamation of Washington Utilities.—The District of Columbia commissioners are opposed to amalgamation of the Washington Railway & Electric Company and the Potomac Electric Power Company, the subsidiary corporation from which it receives its power supply. This announcement is made in a report sent to Congress on the bill introduced by Representative Fairchild to amend an act approved June 5, 1900, giving the Great Falls Electric Railway Company (now Washington Railway and Electric Company) authority to "acquire and hold shares of the capital stock or other securities of any company supplying or under contract to supply electric power in the operation of its railways to it." According to the commissioners the Fairchild bill would permit the complete merger of the two companies, which the law prohibits.

Loose-Wire Negligence.—A telephone company, it was held by the Supreme Court of Michigan (155 N. W. 742), which allowed a loose wire to hang in a street paralleled by a railroad's bare third rail was guilty of negligence.

No Necessity for Employer's Keeping Watch When Proper Protection Is Given.—When a lineman is furnished with proper rubber gloves for working on live wires the employer's foreman is not required to keep watch on the employee to see that he uses the rubber instead of canvas or linen gloves, it was held by the Supreme Court of New York (157 N. Y. S. 185).

Right of Eminent Domain.—In the case of Miller vs. Southern Indiana Power Company (111 N. E. 308) the Supreme Court of Indiana held that a corporation organized by law to furnish electricity for light and power to cities and the public in general is entitled to condemn land for a power site, because the use is a public one and the company is bound at common law to impartially serve the public.

Contributory Negligence.—A person walking on the sidewalk touched a guy wire which was supporting a pole carrying the city's power and fire-alarm wires and was killed; but since no danger was obviously likely to result from the act of touching or grasping the guy wire the Supreme Judicial Court of Massachusetts (111 N. E. 374) held that the person who was killed was not negligent in his deed.

Commission May Waive Contract Rights.—A contract between a municipality and a water company fixing rates to private consumers does not prevent a board of public utility commissioners from fixing a higher rate, as against the objection of the municipality and consumers, since the State, it was held by the New Jersey Supreme Court (95 A. 749), through the agency of the board, may waive the contract rights of the public without improperly impairing the obligation of the contract.

Riparian Rights.—The owner of land, it was held by the Supreme Court of Alabama (70 S. 715), has the right to discharge water falling upon or flowing through his land on the land of one lying below him, and he can be deprived of this right only by his own grant or license or by condemnation for public use, so that any obstructions by the lower proprietor resulting in unnatural enlargement of the stream to the injury of the upper proprietor gives a right of action. A riparian owner, it was held, may erect a dam or detain water for reasonable purposes, but if such acts injure other owners injury results since a man must use his own property with reasonable regard for the rights of others. Moreover, although an owner might acquiesce for a time in an alleged nuisance, the fact that he knows a structure is being built and knows its purpose does not stop him taking action against it as a nuisance because of injuries thereafter arising, as in the case of a dam of a lower owner flooding the property of the upper one, unless he encouraged the building of the structure.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public-utility companies.

Contractors Building Power Plant Not an Electric Company.—The Supreme Court of Georgia (87 S. E. 892) would not hold the Northern Contracting Company as an electric company within the meaning of the law when it was erecting a power plant to be used for the purpose of producing electric energy.

Liability for Defect in System.—In a case for injury caused by tripping over a broken guy wire on a sidewalk which was not broken fifteen minutes before the accident and which was used to hold up a municipal plant's lighting pole, it was held by the Supreme Court of Wisconsin (155 N. W. 938) that the defect in the sidewalk caused by the wire had not existed long enough to charge the city with notice thereof to render it liable. Further, the mere fact that the wire was broken was not evidence of failure in the city's duty of inspection and therefore of negligence.

Right of Action for Injury to Private Property.—The Supreme Court of Alabama (70 S. 737) held in the case of injury to property and health, claimed to be due to the backing up of water, in one of the many cases against the Alabama Power Company, commonly known as the "mosquito" cases, that while it was not possible for one to recover unless damage in health or property is the result of the maintenance of the dam, he might in such case recover if the damages were the result of the company's negligence or if the injuries were the proximate result of the construction of the dam and could have been foreseen at the time of the construction.

Liability for Bodily Injuries Accidentally Suffered.—Of interest to utility operators is the recent affirmation in the United States Circuit Court of Appeals in San Francisco of a judgment secured against the Aetna Life Insurance Company by the Portland Gas & Coke Company covering claims made by the gas company for liability incurred because certain employees of that company caught typhoid fever while doing construction work. The men made claims against the gas company and some suits were brought, all of which were finally settled by the company out of court. The gas company later sued the insurance company on the ground that the claims were for bodily injuries accidentally suffered, which the gas company was insured against in its policy. The gas company received a verdict in the United States District Court at Portland, and the verdict has been affirmed in San Francisco. The amount involved will be approximately $7,500.

Negligence in Guarding Transmission Lines.—Since it is not a customary or approved method to erect cradles or wire netting over a 220-volt insulated line to protect it from uninsulated harmless wire fastened above it, failure to do so is not negligence, it was held by the Supreme Court of Illinois in the case of Pressley vs. the Bloomington & Normal Railway & Light Company (111 N. E. 511). When the wires are owned by a distributing company which receives the energy at the generating company's station, then the generating company is not liable for injury from contact with those wires because it does not know of any defect in the wires, even though the generating company when requested by the distributing company made repairs to the wires.

Liability for Injury Where Wires of One Company Fall on Those of Another.—The Supreme Court of Illinois in the case of Pressley vs. Bloomington & Normal Railway & Light Company (111 N. E. 511) held that an electric company sued for death of a person electrocuted when there fell on its line the wires of another company is entitled to an instruction to the jury that it is not an insurer of the safety of wires or of the public against action and that it was not liable if the death was the result of an action which could not have been foreseen by it. It is also entitled to an instruction that the charge of the declaration of the installation of the wire being defective or improper must be proved by proper evidence, not assumption or presumption or conjecture.

What Constitutes a Public Service Corporation?—Companies furnishing electrical energy may or may not be public service corporations, it was held by the Supreme Court of Washington (154 P. 1110) in the case of the Public Service Commission of Washington vs. the Spokane & Inland Electric Railroad Company, depending on whether the sale of power is a sale to the public generally or only an incident to the business in which the company is engaged, as a sale pending the time when the company's surplus power may be needed to accomplish its assumption of duty to the public. The sale of electric power for traction purposes, lighting, manufacturing, etc., it was held, is not a public use, and the sale by a public service traction company of the difference between its ordinary requirements and its peak load is only an incident to the public employment, of which the law will take no notice. Furthermore, it was held that the public service commission law has not extended the jurisdiction of the commission over a traction company selling its surplus of power so far as such branch of the business is concerned. The regulation and control of business of a private nature by the State is sustained by reference to the police power, and then only when the business is in character and extent of power such as touches the whole people and affects the general welfare, while the act does not manifest clear legislative intent to bring such business within the police power, which the court will not do in the absence of such expressed intent.

Vermont Electrical Association.—Members of the Vermont Electrical Association held their annual meeting at The Wendell, Pittsfield, Mass., on March 20.

Detroit Jovian League.—The Detroit Jovian League held a smoker at the Hotel Tuler on March 24, to stimulate interest in the membership campaign to be conducted.

New York Jovian League.—Dr. Miller R. Hutchison, chief engineer of the laboratory of Thomas A. Edison, addressed the Jovian League of New York City on April 5.

New York Section, I. E. S.—On April 6 Dr. Charles P. Steinmetz spoke before the New York Section of the Illuminating Engineering Society on the subject of "General Problems of Illumination Design."

Ontario Electrical Dealers and Contractors.—The second annual convention of the Electrical Dealers and Contractors' Association of Ontario, Canada, will be held at Toronto on June 5, 6 and 7.

Kansas City Jovian League.—Dr. E. J. Kulp, pastor of the Linwood Boulevard M. E. Church, Kansas City, addressed the Jovian Electric Club of Kansas City, Mo., on March 24, on "The Way to Peace."

Newark Jovian League.—At the regular luncheon meeting on March 23 of the Newark (N. J.) Jovian Electrical League Paul F. Lupte, superintendent of the southern division of the Public Service Electrical Company, spoke on the topic "Superspecialization."

Los Angeles Jovian League.—At the regular meeting of the Jovian Electric League of Los Angeles, on March 22, T. Harvey Dukelow, claim agent of the Southern California Edison Company, spoke on the "Workman's Compensation and Insurance Law" which became effective in the State of California on Jan. 1, 1914.

Engineers' Society of Western Pennsylvania.—At a recent meeting of the Engineers' Society of Western Pennsylvania, held in Pittsburgh, Pa., P. Junkersfeld, assistant to the vice-president of the Commonwealth Edison Company of Chicago, Ill., led the discussion on the topic, "Electric Service Problems and Possibilities."

Washington Contractors and Dealers.—The organization of the State of Washington Electrical Contractors and Dealers has recently been perfected with the following officers: President, W. H. Byers of Nepage, McKenny & Company; vice-president, S. M. Jones of John A. Roeblings Sons Company, and secretary-treasurer, Roy Worth of the Pacific States Electric Company.

California Association of Electrical Contractors and Dealers.—The third quarterly meeting of the year 1915-1916 of the California Association of Electrical Contractors and Dealers convened on April 6 at 1.30 p. m. at the Hotel Oakland, Oakland, Cal. In the evening the Association of Electrical Contractors and Dealers and Jobbers held its regular monthly meeting and dinner at the same place.

Associations and Societies

A complete Directory of Electrical Associations is regularly printed in the first issue of each month on the next-to-last text page.

N. E. L. A. Committee Meetings.—The executive committee of the technical section of the National Electric Light Association met on Friday in New York and the executive committee of the commercial section met on Saturday in Chicago to arrange the program for their respective section meetings at the annual convention of the association to be held in Chicago the week of May 22. The lamp division met in New York on Thursday for the purpose of adopting its annual report.

Chicago Electrical Societies.—A joint meeting of the electrical section of the Western Society of Engineers, the Chicago section of the American Institute of Electrical Engineers and the Chicago section of the electric vehicle section of the National Electric Light Association will hold a meeting on April 24, when four fifteen-minute papers devoted to the problems of central stations in cities of 50,000 inhabitants and less will be delivered by A. J. Goedjen, Indianapolis, Ind.; Adam Gschwindt, Rockford, Ill.; A. Hargrave, Chicago, and R. L. Fitzgerald, Winnetka, Ill.

Pacific Coast Section A. I. E. E.—The Pacific coast section of the American Institute of Electrical Engineers will hold its convention at Seattle, Wash., on Sept. 5, 6, 7 and 8, with a morning and afternoon session on Sept. 15, a morning and evening session on Sept. 6 and an executive session on the afternoon of Sept. 8, thus giving an opportunity to Institute members to attend the important sessions of the Northwest Electric Light & Power Association on the afternoon of Sept. 6 and 7. The range committee report will be discussed Thursday afternoon. Friday evening the annual banquet will take place, which will be a joint affair of both associations.

American Institute of Electrical Engineers.—The 320th meeting of the American Institute of Electrical Engineers will be held in the Engineering Societies Building, New York City, on the evening of April 14. The subject of the meeting will be "Direct-Current Electric Railways," and a paper will be presented by Clarence Renshaw of the Westinghouse Electric & Manufacturing Company, entitled "High-Voltage, Direct-Current Railway Practice." The author will show first the fundamental differences in apparatus for 1200 or 1500 volts as compared with the former 600-volt standard, and will point out the tendency to reach an ultimate maximum by slight increases in voltage for successive installations.

Meeting of Louisville Jovians.—Forty-two men were received into the Jovian order at the annual meeting of the organization held in Louisville on the night of March 17. This brings the membership in Louisville up to 175. Rather elaborate preparations were made for the initiation, which was carried off in style, while it was preceded by the annual banquet. This was held in the Red Room at The Seelbach, members and candidates then adjourning upstairs to the auditorium for the ceremonies. Robert Montgomery, first tribune, presided as toastmaster at the banquet, and speeches were made by Frank H. Miller, president of the League; Donald McDonald, general manager of the Louisville Gas & Electric Company; Judge Matt O'Doherty, counsel for the company, and James Clark, Jr., who was first of the first tribunes in Kentucky. President Miller has some rather extensive and ambitious projects for the league to carry out during the year. They are to be developed later on.

Cleveland (Ohio) Electrical League Secures 702 Members in Its Whirlwind Campaign.—The week's membership campaign of the Cleveland Electrical League, ended at 1.30 o'clock last Thursday afternoon, resulted in the acquisition of 702 members, instead of the 500 for which the organization aimed in the beginning. This gives it a membership of 1200. M. G. Buchan, general in charge of the campaign, was presented with a handsome revolver. His aids were George S. Milner and A. B. Wilson, and his orderly, R. S. Dunning, secretary of the league. There was a difference of only nine applications between the two contending regiments, but possibly some changes may be made on the score of eligibility, so the winners have not yet been announced. S. E. Doane of the National Lamp Works will give his personal attention to the lighting plan of the new crystal clubrooms on the roof of Hotel Statler, and it is proposed to have the most beautifully lighted interior in the country.

Electric Vehicle Section, N. E. L. A.—The papers to be presented at the electric vehicle section meeting of the National Electric Light Association convention to be held in Chicago during the week of May 22 have been announced as follows: "Central Station Assistance in Promoting Electric Vehicle Use," by W. P. Kennedy, consulting transportation engineer, New York City; "Exchange Battery Systems," by P. D. Wagoner, president of the General Vehicle Company, Long Island City, N. Y.; "Passenger Vehicle Problems and Activities," by E. P. Chalfant, Eastern representative of the Anderson Electric Car Company, New York City; "Greater Garage Service," by Harry Salvat, proprietor Fashion Auto Garage, Chicago, Ill.; "The Relation of Tires to Electric Vehicle Efficiency," by S. V. Norton, manager of the truck tire sales department of the B. F. Goodrich Company, Akron, Ohio; "Electric Truck Troubles and How to Minimize Them," by F. E. Whitney, general manager of the Commercial Truck Company of America, Philadelphia, Pa., and "Industrial Truck Applications," by C. W. Squires, Jr., sales manager of the General Vehicle Company, Long Island City, N. Y.

FINANCE, COMMERCE AND INDUSTRY

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Manufacturing and Industrial

Production Costs Rapidly Rising

Special reports received by the Federal Reserve agent for Philadelphia from firms engaged in the manufacture and sale of electrical supplies apparatus in the Philadelphia Federal Reserve district indicate a considerable rise in production costs during the past year. Of the replies received, four in number, all reported business to be normal, two reported the outlook to be good, while two others were divided between the outlook as fair and as uncertain. Three reported profits had not increased proportionately with cost, but had for the fourth one. The average increase during the past year in the cost of wages from the four replies was 15 per cent, and in materials was 37 per cent. These figures correspond with an average of 11 per cent in wages and 46 per cent in materials, during the past year for the industries throughout that district. The percentage increase in cost of materials for the electrical industry, however, was much greater than that for most of the other industries. The higher general average was due to the increase in two industries in particular, one of which reported an increase of 395 per cent and the other an increase of 100 per cent.

Advance in Prices of Distribution Transformers

Another advance in the price for distribution transformers, or those rated at 200 kva. and under, was announced on April 1 by two of the largest manufacturers of this class of electrical apparatus. These transformers have become so standardized that they are usually ordered from stock.

In anticipation of this advance in prices these same manufacturers urged their customers to place their orders for future delivery before April 1 so as to take advantage of the lower prices. With costs of raw materials and labor continually advancing and with no apparent prospect of either becoming lower for some time, it was logical, the manufacturers stated, for buyers to make contracts in anticipation of the probable use of the goods. Central stations, which are the largest purchasers of distribution transformers, by such foresight, will benefit, first, by a saving in cost, and, second, a consideration of paramount importance, by prompt delivery. The manufacturers point out that by knowing months in advance the demand that will be made on their stocks they can be in a position to anticipate their customers' wants and make shipments on receipt of order or if delivery dates have been specified promptly to fulfill their obligations.

The manufacturers, on the other hand, as one of them expressed it, will reap the advantages of a high manufacturing load factor. With a fairly accurate knowledge of the volume of buying to be done for the next twelve months gained either from actual orders with specified deliveries or from a careful estimate based on the purchasing of these same customers over a period of years, the manufacturers can so route the work through the shops that the peaks and valleys in the production curve will be greatly smoothed out. They have also been able to estimate with far greater accuracy than before, it is stated, their raw product requirements so as to be able to insure prompt deliveries and themselves gain the benefits of lower prices.

Stone & Webster have removed their New York offices to the Equitable Building, 120 Broadway.

W. H. Patchell, engineer, has removed his offices from Caxton House, Westminster, London, S. W., England, to 64 Victoria Street, London, S. W.

The Wagner Electric Manufacturing Company of St. Louis has removed its Pittsburgh office to 947 Penn Avenue. This office will continue to be in charge of Ludwig Hommel.

Quinton Adams has recently joined the San Francisco sales force of the Westinghouse Electric & Manufacturing Company, having been transferred from the New York office of the company.

The Adams-Bagnall Electric Company, Cleveland, Ohio, has appointed A. D. Fishel, formerly manager of the distributing transformer section of the supply department of the Westinghouse Electric & Manufacturing Company, as commercial manager.

Big Business in Farm-Lighting Outfits.—Fairbanks, Morse & Company, Chicago, Ill., are noting a large demand for their farm-lighting equipment. Business in the company's motors and other electrical products is also very satisfactory at the present time.

L. O. Beard, who for ten years has been connected with one of the largest factories in the United States manufacturing electric clocks, will soon open an establishment of his own in Lancaster, Pa., for manufacturing an electrically operated timepiece which he has developed.

The Interstate Electric Novelty Company has moved into its new factory at 104 South Fourth Street, Brooklyn, N. Y. The new plant has been necessitated on account of a large increase in the company's flashlamp business. It is seven stories high and contains 100,000 sq. ft. of floor space.

The Edmunds & Jones Corporation, Chicago, Ill., has recently been formed and is a consolidation of the Edmunds & Jones Manufacturing Company of Detroit, the Canadian Lamp & Stamping Company of Ford City, Ont., and the Chicago Electric Manufacturing Company. The new company will be engaged in the manufacture of various types of electric automobile lamps.

The I. P. Morris Company, Philadelphia, Pa., has just received an order from the Phoenix Construction Company (Electric Bond & Share Company) for one 10,500-hp. turbine of the vertical-shaft, single-runner type to operate under a head of 90 ft. at a speed of 171.5 r.p.m. This turbine will be part of the equipment of the Cove development of the Utah Power & Light Company.

The Tri-City Electric Company of Moline, Ill., and Davenport, Iowa, during the month of March completed the first twenty years of its corporate existence, which rounded out the full period of its original charter issued by the State of Iowa, March 2, 1896. It has been reincorporated for another term of twenty years to engage in the business of electrical contracting and dealing in supplies and fixtures.

The General Insulate Company, 1008 Atlantic Avenue, Brooklyn, N. Y., manufacturer of molding insulating compound, has just broken ground for an addition to its present plant in Brooklyn and has contracted for additional equipment which will materially increase the output of its plant. Several departments of the company have been working nights and holidays for some time past to take care of the business being received.

Opportunities in the Island of Jamaica for Electric Vehicles.—In a recent communication from the consular department of the Island of Jamaica, the Electric Vehicle Association of America has been informed that never has the time been so opportune in that district for the introduction of battery-propelled vehicles. Within the past few years automobiles of all classes, both commercial and passenger, have been used in increasing numbers. The roads in Jamaica, it is stated, are excellent.

State of Massachusetts Awards $15,000 Lamp Contract.—The Hygrade Lamp Company, Salem, Mass., announces that the State of Massachusetts has awarded it a contract for lamps amounting to $15,000. This is the second consecutive year that the State of Massachusetts has awarded the Hygrade Company an exclusive contract for lamps. The company has recently moved into its new plant at 60 Boston Street, Salem, Mass.

Canadian Hotpoint Electric Heating Company.—Frederick P. Combier, who has been representing the Hotpoint Electric Heating Company in the Middle West, has now been transferred to the company's Toronto (Canada) office, where he will have charge of Canadian sales. Mr. Combier has been with the Hotpoint company for several years, during which time he has represented the organization in the East and in the territory centering about the cities of St. Paul, St. Louis, Kansas City, Dallas and New Orleans.

The X-Ray Reflector Company of New York has recently been formed to take over the New York business of the National X-Ray Reflector Company and the Eye Comfort Lighting Shop. The headquarters of the company will be maintained at 21 West Forty-sixth Street. The officers of the company are as follows: Augustus D. Curtis, president; Ralph B. Corby, vice-president; L. H. Graves, secretary, and H. R. Eldredge, treasurer. All of the above-named officers have been connected with the National X-Ray Reflector Company for some time. All of the products of the National X-Ray Reflector Company of Chicago will be handled by the new corporation.

Underwriters' Laboratories, Chicago.—J. E. Latta, special agent of the Underwriters' Laboratories, addressed the Kansas City Association of Credit Men (Wholesale) on Thursday evening, March 23, outlining the work of the laboratories, and urging co-operation by business men so that the standards approved by them might receive wider acceptance and further prevent hazards from the use of unsafe equipment. Speaking of the charges made by the laboratories for inspections, he said that $1,600 had been returned last year to the rubber-covered-wire industry, the estimated charge for labels having been 2 cents per label in excess of the actual cost of the work.

Electric Flags for Kansas City Territory.—The Kansas City Light & Power Company recently received the first electric flag brought to Kansas City territory, and it is now in place on one of its buildings. The Federal Sign System's Kansas City branch also has just received its first allotment of the new signs. Among the recent purchasers of these signs are the St. Joseph Railway, Light, Heat & Power Company, two signs; the City Light & Traction Company, Sedalia, Mo.; the Topeka (Kan.) Edison Company; Kansas State University, Lawrence, Kan.; the Kansas Gas & Electric Company, Wichita, Kan., two signs, and Kansas City Chapter, Daughters of the American Revolution. The last-named sign was a feature of a recent Baby Week celebration.

Big Business for General Electric Company.—The General Electric Company is receiving orders, it is reported, at the rate of $3,000,000 a week which, if continued, will mean more than $150,000,000 of business for the year. Should the bookings continue at the above-named rate for several more months the company will have on hand at the end of the year, it is stated, the greatest volume of unfilled orders in its history. To the amount of business booked this year must be added approximately $20,000,000 of contracts unfilled at the close of 1915. A feature of the thousands of contracts now being received by the General Electric Company is said to be the fact that by far the greater part is in small orders; that is, less than $25,000 each. The smallness of the orders indicates to a considerable extent the general prosperity of the country.

Electric Systems for Gasoline Automobiles.—Among the new distributors recently signed up for Westinghouse starting, lighting and ignition systems for Ford cars is the Central Rubber & Supply Company of Indianapolis, Ind. S. F. Dupree, Jr., has recently returned from an extensive trip in the interest of Westinghouse starting, lighting and ignition systems for Ford cars and reports that the business outlook for this class of apparatus is exceptionally promising this year. On his trip he arranged for distribution of this product by six more concerns in the territory covered. The Owen Schoenck Company of Chicago, Ill., has also closed a contract with the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., for electric starting and lighting equipments for its six-cylinder trucks. The equipments will consist of type No. 750 starting motors and type No. 202 lighting generators.

Landers, Frary & Clark Window-Display Contest.—During November of last year the firm of Landers, Frary & Clark, manufacturers of cutlery and hardware, New Britain, Conn., inaugurated a window-trimming contest, offering cash prizes for the best three windows exhibiting electrical devices and using the window trim furnished by the company. Electrical dealers throughout the country responded to the idea with considerable enthusiasm, and the Landers, Frary & Clark Company received photographs of a number of very attractive displays. Of these, according to the announcement just issued by the company, the exhibit made by the New Bedford (Mass.) Gas & Electric Light Company was awarded the first prize of $25; the second prize of $15 went to the municipal light department of Reading, Mass., and the third prize, $10, was awarded to the Worcester (Mass.) Electric Light Company. Because of the attractiveness and originality of the following companies' displays honorable mention was also made of the exhibits submitted by the Electric Supply Company, Tulsa, Okla.; the Electric Store, Detroit, Mich.; the Post-Glover Electric Company, Cincinnati, Ohio, and the Toronto Hydro-Electric System, Toronto, Ontario.

General Vehicle Trucks for Municipalities.—Rapid progress is being made in the introduction of its electric trucks among municipalities, the General Vehicle Company of Long Island City reports. The New York street cleaning department has recently purchased two 2-ton platform and stake trucks for general utility purposes, thus supplementing its two 5-ton electric garbage tractors and its twelve 7.5-ton gas-electric tractors. Another General Vehicle Company electric truck is being used by the New York department of water supply, gas and electricity. Still another interesting order is one recently received for six 3.5-ton electric sprinklers for the city of Boston. The first General Vehicle Company's electric truck in Boston city service was a worm-drive patrol wagon, a duplicate of which has recently been ordered. The foreign sales of the General Vehicle Company are also holding up well, it is reported; in fact, the sales in such far-off cities as Sydney and Melbourne, Australia; Capetown and Johannesburg, South Africa, and various towns in Great Britain show up better than those made in many American cities. Three gold-mining companies in South Africa, one of them said to be the largest in the world, have also recently purchased electric trucks. One truck was recently sent to Shanghai and two more to Cuba. There are now nearly sixty General Vehicle trucks in Manila, in Brazil and Argentina. Sales to the coal trade, the company reports, are very encouraging, and among the new fields broken into are the cold-storage, hotel buses (foreign), plumbing and ship-supplies industries.

Signs to Flash News Bulletins in Twenty-Six Cities.—The Peerless Electric Sign Company of 610 Reliance Building, Chicago, has contracted to build sixty-three of its patented electric signs to be installed in twenty-five cities in this country. Each of these signs is to be constructed like one which is now operating at the corner of Dearborn and Washington Streets, Chicago. It is a 50-ft. by 40-ft. roof sign, wired in connection with a keyboard so that any message can be flashed on the sign panel in about twenty seconds. The sign panel is eighteen letters long and four letters deep, and carries in all 3600 10-watt lamps. Forty miles of wire are used in connecting the sign lamps to the keyboard. With the sign in operation it is possible to flash three messages per minute, so that in a six-hour evening 1080 messages can be flashed on the sign. According to the company's plan eighty of these flashes are given to a local newspaper so that news bulletins can be flashed free of charge. The sign company pays for a private telephone line between the newspaper office and the booth which houses its keyboard operator. The remaining 1000 flashes are sold to commercial concerns at the rate of 15 cents a flash. The price for similar service in Kansas City, Mo., is 25 cents, and in New York City it is 40 cents. The sign company's most popular con-

tract calls for one flash every fifteen minutes, which would mean twenty-four flashes per night, or an advertising expense of $3.15 per night. With this arrangement each flash can be the same as its predecessor, or each may be different. Signs have been contracted for as follows: New York, eight; Boston, three; Portland, Me., one; Philadelphia, five; Washington, two; Baltimore, one; Newark, N. J., one; Pittsburgh, six; Buffalo, one; Cleveland, one; Indianapolis, one; Cincinnati, one; Toledo, one; Milwaukee, one; Chicago, twelve; Seattle, two; Minneapolis, three; St. Paul, one; Portland, Ore., two; Spokane, two; San Francisco, one; Los Angeles, two; New Orleans, one; St. Louis, three, and Kansas City, Mo., one. Each of these signs is sold to a separate local company, which is organized by a promoter who capitalizes his organization at $70,000, which is a fair figure considering the earning capacity of the sign. Of this amount $25,000 is used as the purchase price of the sign and $35,000 of the stock is distributed by the promoter among business men whose influence will tend to increase the popularity of the sign as an advertising medium. The plan is said to be meeting with considerable favor and the sign, especially on occasions such as that of the Moran-Willard fight, has proved popular in Chicago.

NEW YORK METAL MARKET PRICES

	March 28 Selling Prices Bid	Asked	April 4 Selling Prices Bid	Asked
Copper	£ s d		£ s d	
London, standard spot	113 0 0		116 0 0	
Prime Lake	26.87½ to 27.12½†		27.50 to 28.00†	
Electrolytic	26.87½ to 27.12½†		27.50 to 28.00†	
Casting	25.50 to 25.75†		26.00 to 26.50†	
Copper wire base	28.25 to 28.75†		29.00 to 29.50†	
Lead	7.00		7.50	
Nickel	45.00 to 50.00		45.00 to 50.00	
Sheet zinc, f.o.b. smelter	25.00†		25.00†	
Spelter	17.67½ to 17.80†		17.92½ to 18.17½	
Tin, straits	50.00†		51.00†	
Aluminum, 98 to 99 per cent	57.00 to 59.00†		57.00 to 59.00†	

OLD METALS

Heavy copper and wire	21.00	to 21.50†	21.50	to 22.00†
Brass, heavy	13.50	to 14.00†	13.50	to 14.00†
Brass, light	11.00	to 11.50†	11.00	to 11.50†
Lead, heavy	6.50	to 6.62½†	6.65	to 6.87½†
Zinc, new scrap	15.50	to 16.00†	15.50	to 16.00†

COPPER EXPORTS

Total tons for March	24,231

†Nominal.

Corporate and Financial

American Cities Company, New York, N. Y.—In his annual report to the stockholders for the year ended Dec. 31, 1915, Hugh McCloskey, president of the company, states that the gross earnings decreased during the year $618,207, the operating expenses and taxes increased $37,439, deductions including interest charges increased $170,469, thereby making a decrease in income applicable to dividends on stocks of $826,115. "The decrease in gross earnings was due entirely to the general business depression," he said, "resulting from the European war and the so-called 'jitney automobile' competition, both of which conditions were only temporary, as was shown by the increased earnings in the last three months of the year affected by the adjustment of business conditions and regulatory measures for jitney automobile operations, effected in the interest of public safety, passed by the legislative bodies in the communities which they served, which practically eliminated this competition."

American Public Service Company, New York, N. Y.—An issue of $300,000 of 6 per cent convertible gold notes due March 1, 1919, is being offered at 100.5. A portion of the proceeds of the notes will be used in part payment for the public utility properties at Henryetta, Okla., and for the cost of improvements, extensions and additions to the properties of the constituent companies. The notes are a direct obligation of the company and are convertible for each $1,000 note into either (a) $500 principal amount of first lien 6 per cent gold bonds, $500 par value of 7 per cent cumulative preferred stock and $100 par value of common stock, or (b) $1,000 par value of 7 per cent cumulative preferred stock and $200 par value of common stock.

C. F. Burgess Laboratories, Madison, Wis.—This corporation, which carries on an electro chemical engineering business, has increased its capitalization to $100,000.

Cincinnati (Ohio) Gas & Electric Company.—On March 27 the stockholders approved the modified agreement with the Union Gas & Electric Company, as outlined in the ELECTRICAL WORLD of March 4, which includes the authorization of a bond issue of $15,000,000, of which $4,100,000 is to be used for the construction of a new plant on the river front at the foot of Rose Street and $400,000 for improvements made on the property. Application was made to the Ohio Public Utilities Commission on March 28 for authority to issue $15,000,000 of first sinking fund 5 per cent bonds to run forty years and permission to sell $4,500,000 of these bonds at 95 was requested.

Commonwealth Edison Company, Chicago, Ill.—An issue of $2,631,000 of the company's first-mortgage 5 per cent gold bonds, due June 1, 1943, is being offered to investors. Previous issues of these bonds are listed on the Chicago Stock Exchange, and application will be made to list this issue.

Empire District Electric Company, Joplin, Mo.—A block of first mortgage 5 per cent sinking fund gold bonds due Nov. 1, 1949, is being sold at a price to net the investor about 5.5 per cent.

Midland Counties Public Service Corporation, San Luis Obispo, Cal.—The California Railroad Commission has authorized the company to issue promissory notes for $100,089 to refund outstanding notes.

New England Power Company System, Boston, Mass.—The year 1915 was the most successful year which this system has ever experienced, it was stated by George S. Smith, president of the system, in his report to the stockholders for the year ended Dec. 31, 1915. The output for 1915 was 173,000,000 kw.-hr., which does not include the equivalent of 50,000,000 kw.-hr. sold at Bellows Falls in water instead of electricity. The 1915 output was 53,000,000 kw.-hr. greater than the 1914 output. So great is the demand for power, Mr. Smith says, that the greatest problem which confronts the companies is the creation of an increased supply of energy to meet the increased demand. This increased demand is due not merely to the great business activity of the time, it is stated, but even more to the fact that the purchase of electricity by manufacturing and utility companies has proved so profitable and desirable that companies are hastening to avail themselves of its benefits. The dam and hydraulic plant of the National Metal Edge Box Company, which was purchased in July, 1915, has been rebuilt and a hydroelectric generating station is now under construction and was to be in operation about April 1. The ownership of this property, with its available head of 72 ft., according to the report, gives the companies the entire control of the Deerfield River from a point just south of Wilmington to Shelburne Falls, Mass., a distance of 35 miles. The plant will add approximately 12,000,000 kw.-hr. yearly to the output of the system and will also give a materially increased supply of summer power, as the stored waters of the Somerset Reservoir will be utilized through the wheels of this new plant. The statement of earnings and expenses for the calendar year 1915 of the system, which is composed of the New England Company, the New England Power Company and the Connecticut River Power Company, is as follows:

Gross earnings	$1,489,453
Operating expenses and taxes	531,554
Net earnings	$957,899
Bond and note interest	512,827
Net corporate income	$445,072
Dividends	319,401
Surplus	$125,671

Northern States Power Company, Chicago, Ill.—A further step in the consolidation of the funded debt of the company and subsidiaries has been taken in the calling for redemption of bonds and notes of the various subsidiaries. Among the securities called for redemption on May 1, 1916, are: All of the outstanding twenty-year, 5 per cent gold bonds of the Consumers' Power Company of Minnesota, amounting to $7,210,000 of an authorized issue of $10,000,000, dated Nov.

1, 1909, and all of the outstanding notes amounting to $1,434,500 of the $3,000,000 authorized issue of 6 per cent collateral lien notes of the Consumers' Power Company of Minnesota, dated Nov. 1, 1913, due May 1, 1917. The following are called for redemption on June 1, 1916: All of the outstanding five-year, 6 per cent, collateral lien notes of the Northern States Power Company, amounting to $5,000,000, being the full authorized issue, dated June 1, 1912, and all of the outstanding three-year, 6 per cent, coupon gold notes, amounting to $3,000,000, of the Minneapolis General Electric Company, dated June 1, 1914.

Public Service Company of Northern Illinois, Chicago, Ill.—A block of first and refunding mortgage 5 per cent gold bonds has just been sold to investors. The present market price is around 95.

Republic Railway & Light Company, New York, N. Y.—Business in the territory served by the company decreased to some extent during the early part of the year 1915, it was stated in the annual report, although not so notably as in other districts, owing to the diversification of industries located in this territory. During the latter part of the year conditions improved and are now prosperous. The demand for electrical energy, particularly for motor service, developed so rapidly that work was begun upon an extension of the generating plant at Lowellville, Ohio, which will increase the capacity of that plant from 20,000 hp. to 40,000 hp. During the year the light and power business increased 15.9 per cent and the total number of customers connected at Dec. 31, 1915, was 16,982, a net increase of 3091. More than 10 miles of 22,000-volt transmission lines were built during the year to take care of increasing demands and further extensions are now under construction, including a 66,000-volt steel tower line between the power station at Lowellville, Ohio, and Ellwood City, Pa. The comparative income account for the twelve months ended Dec. 31, 1915 and 1914, follows:

	1915	1914
Operating revenue	$3,121,297	$3,001,285
Operating expenses and taxes	1,874,083	1,856,467
Net earnings	$1,247,214	$1,144,818
Non-operating income	1,753	176
Gross income	$1,248,967	$1,144,994
Interest charges	688,952	679,987
Net income	$560,015	$465,007
Preferred stock dividend	311,484	311,484
Balance	$248,531	$153,523

New Utility and Industrial Companies

The D. & M. Manufacturing Company of Indianapolis, Ind., has been incorporated with a capital stock of $12,000 by Oscar Dietz, Clarence E. Mills and W. D. Jones. The company purposes to deal in electrical appliances.

The Iowa Light, Heat & Power Company of Grinnell, Iowa, has been chartered with a capital stock of $1,000,000. The officers are: Lindsey Hooper, president; Manning A. Williams, vice-president, and Charles A. Olsen secretary and treasurer.

The Electric Specialties Manufacturing Company of Benton Harbor, Mich., has been incorporated with a capital stock of $35,000. The officers are: Walter Von Hofen, president; W. S. Robinson, vice-president; H. S. Gray, secretary, and W. H. Seitz, treasurer.

The Northwestern Power & Manufacturing Company of Wilmington, Del., has been incorporated with a capital stock of $750,000 to acquire real estate, power sites, water rights, etc. The incorporators are: Herbert E. Latter, Norman P. Coffin and Clement M. Egner.

The General Public Service Corporation of Philadelphia, Pa., has been incorporated by William White, William A. Welsh of Philadelphia, Pa., and R. R. Kenney of Dover, Del. The company is capitalized at $100,000 and proposes to conduct a general electric lighting business in all its branches.

The Victory Motor Company of New York, N. Y., has been incorporated with a capital stock of $5,000 to manufacture and deal in motors, engines, power generators, boats, vehicles, etc. The incorporators are W. J. Powell, J. K. M. Ewing and W. L. Sayers, 31 Nassau Street, New York, N. Y.

The Auth Electrical Specialty Company of Brooklyn, N. Y., has been chartered with a capital stock of $25,000 to do a general contracting and engineering business and to deal in hardware, metals, cutlery, etc. The incorporators are A. H. Stiehl, E. and C. Auth, 859 East Seventeenth Street, Brooklyn, N. Y.

Row & Davis, Engineers, have filed articles of incorporation with a capital stock of $5,000 for the purpose of doing a general electrical, mechanical, metallurgical and chemical engineering business and to act as founders, metal workers, fixture manufacturers, etc. The incorporators are E. M. Souza, H. C. Davis and R. R. Row, 90 West Street, New York, N. Y.

Trade Publications

Guy-Wire Protector.—The Specialty Device Company, Cincinnati, Ohio, has brought out an illustrated leaflet descriptive of its protector for guy wires.

Cycloid Weir Meter.—Bulletin No. 42, entitled "Kennicott Cycloid Weir Meter," is illustrated and has been issued by the Kennicott Company, Chicago Heights, Ill.

Ornamental Lighting Fixtures.—Shapiro & Aronson, 20 Warren Street, New York, have published an illustrated pamphlet which describes their Roman bronze fixtures.

Stokers.—The Rosedale Foundry & Machine Company, Pittsburgh, Pa., has brought out an attractively illustrated catalog which describes its Type A and Type B Playford stokers.

Recording Instruments.—Bulletin No. 231, issued by the Bristol Company, Waterbury, Conn., is descriptive of a recording frequency meter and Bulletin No. 138 of an electric time recorder.

Adjustable-Arm Lighting Fixture.—The Universal Appliance Company, Worcester, Mass., has prepared an illustrated folder which is descriptive of its adjustable-arm lighting fixture.

Concentric-Wiring Devices.—The General Electric Company, Schenectady, N. Y., has issued Folder B-3362-2, which describes and illustrates various types of devices for surface concentric wiring.

Ornamental Lighting Fixtures.—The International Chandelier Company, 176 Grand Street, New York, has issued a large-sized catalog which illustrates and lists various types of ornamental lighting fixtures.

Electrical House Goods.—Catalog No. 6, issued by Edwards & Company, 140th and Exterior Streets, New York, is illustrated and made up of eighty-eight pages and lists various types of electrical house goods.

Single-Phase Furnaces.—The Snyder Electric Furnace Company, Chicago, Ill., has published an illustrated bulletin which is descriptive of its single-phase single-electrode electrically-operated furnaces for making and refining steel.

Porcelain Sockets and Fixture Switch.—Pass & Seymour, Inc., Solvay, N. Y., have issued illustrated leaflets on their "Mogul Shurlok" porcelain sockets, with an attachment for preventing the theft of lamps, and their "Fluto" fixture switches.

Outdoor Substations.—The Railway & Industrial Engineering Company, Pittsburgh, Pa., has prepared an interesting folder which contains numerous illustrations of actual installations of its outdoor substations and other power equipment.

Small Electric Stoves.—The Stoneware Electric Stove Works, 136 Liberty Street, New York, is sending out an illustrated folder which contains information on its Class A, Class B and Class C ornamental stoves made of asbestos and soapstone.

Automatic Motor-Driven Typewriters.—The Hooven, Owens, Rentschler Company, Hamilton, Ohio, has prepared an illustrated catalog descriptive of its new automatic electrically operated typewriter and its electric perforator for producing a perforated sheet from which form letters are printed on the automatic typewriter.

New England

PORTLAND, ME.—Preliminary work has been commenced by the Cumberland County Power & Light Company of Portland in connection with the construction of a 20,000 hp. hydroelectric power plant at Hiram Falls on the Saco River. The plans provide for the development of about 6000 hp., at a cost of about $500,000, which will include a dam, power station and. equipment. The generating station will be located on the Baldwin side of the river. A. H. Ford is general manager.

LYNN, MASS.—Bids will be received at the office of the commissioner of water and water works, City Hall, Lynn, until April 20 for one 3,000,000-gal. horizontal centrifugal pump; also for one 200-hp. electric motor. Specifications may be obtained at the above office. Thomas Campbell, 2d, is commissioner of water and water works.

WORCESTER, MASS.—The Worcester Electric Light Company has engaged H. R. Kent & Company, engineers, 141 Broadway, New York, N. Y., to prepare plans for the erection of new building at the Webster Street station of the company.

WORCESTER, MASS. — Improvements and extensions are contemplated by the Worcester Electric Light Company, including additions to building, installation of a Westinghouse 20,000-kw., 13,200-volt turbine extensions to ornamental lighting-system (175 6.6-amp. magnetite arc lamps) and additions to the 13,200-volt underground cable transmission system. F. H. Smith is assistant manager.

PROVIDENCE, R. I.—Preparations are being made by the Narragansett Electric Lighting Company of Providence to place 3 miles of its overhead wires underground this year.

DANIELSON, CONN. — Arrangements have been made by the Attawaugan Company for lighting more than 175 tenements in the villages of Attawaugan, Ballouville and Pineville, the service to be supplied by the Danielson & Plainfield Gas & Electric Company. Work will begin as soon as possible on the erection of the lines. The company, it is understood, will soon have to increase the output of its generating plant at Plainfield .

Middle Atlantic

BROOKLYN, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, Park Avenue and Fifty-ninth Street, New York, until April 17 for installing electric-light equipment in Public Schools 34, 37, 79, 82 and 111. A separate proposal must be submitted for each school. Specifications, etc., may be obtained at the above office or at the branch office, 131 Livingston Street, Brooklyn.

BROOKLYN, N. Y.—Bids will be received by L. H. Pounds, president of the borough of Brooklyn, Borough Hall, Brooklyn, until April 12, for furnishing material and constructing switchboard room for pumping station, section 3 of storm sewer and sanitary sewer in North Henry Street, from Calyer Street to Greenpoint Avenue, and the outlet sanitary sewers, with accompanying storm sewers in Greenpoint Avenue from North Henry Street to Jewell Street, together with a pumping station, pump well and appurtenances, at the intersection of Greenpoint Avenue and Jewell Street. Blank forms and further information may be obtained and plans and specifications may be seen at the office of the Bureau of Sewers, borough of Brooklyn, 215 Montague Street, Brooklyn.

LYSANDER, N. Y.—The town of Lysander has granted the Fulton (N. Y.) Light, Heat & Power Company permission to supply electricity here. The line will be operated in connection with the service to Phoenix.

NEW YORK, N. Y.—The Interborough Rapid Transit Company is planning to construct a new substation (60 ft. by 100 ft., one story high) on River Street, near 162d Street, to cost about $40,000. George Pegram is chief engineer, 165 Broadway, New York.

NEW YORK. N. Y.—Bids will be received by William Williams, commissioner of water supply, gas and electricity, Room 2342. Municipal Building, Manhattan, until April 15, for furnishing cast-iron lamp posts. Specifications, etc., may be obtained at the above office.

NEW YORK, N. Y.—Bids will be received by the Board of Water Supply, twenty-second floor, Municipal Building, New York, until April 18, for furnishing and erecting nine electrically-driven traveling cranes, from 5 to 20 tons capacity, with equipment, in chambers at Ashokan, Kensico and Hill reservoirs. Pamphlets containing information for bidders, specifications, etc., may be obtained at the above address upon deposit of $10.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

ROCHESTER, N. Y.—The Rochester Railway & Light Company has placed a contract with the I. P. Morris Company, Philadelphia, Pa., for two 16,000-hp. turbines of the vertical shaft, single runner type, to operate under a head of 130 ft. at a speed of 180 r.p.m. These turbines will be controlled by I. P. Morris governors.

CATASAUQUA, PA.—The Council has authorized Bascom & Sieger, borough engineers, to secure estimates of the cost of installation and maintenance of a municipal electric-lighting plant in Catasauqua and to report to the Council.

KOPPEL, PA.—A high-tension transmission line is being erected from Koppel to Darlington by the Harmony (Pa.) Electric Company. Later the line, it is expected, will be extended to Enon Valley and Lisbon, Ohio and towns farther west. The company has recently placed transformers at North Sewickley and at Frisco, near Ellwood City.

LANSDALE, PA.—The question of removing the municipal electric-light plant from its present location in the city to Chalfont, 6 miles east of Lansdale, where water power is available is reported to be under consideration by the City Council.

MEADVILLE, PA.—The Northwestern Electric Service Company of Pennsylvania, which recently took over the property of the Peoples' Incandescent Light Company of Meadville, and the Northwestern Pennsylvania Railway Company are planning extensive improvements, including the erection of a high-tension transmission line from Erie to Harmonsburg, and the construction of an electric railway from Venango to Silverlings Corner near Cambridge Springs, 3½ miles long. Charles M. Hatch is vice-president and general manager.

SHENANDOAH, PA.—Bids will be received by James J. Ringler, secretary of borough council, 104 North Jardin Street, Shenandoah, until April 20, for furnishing and maintaining electric arc or incandescent lamps for lighting the streets of the borough of Shenandoah for period of five and ten years from April 15, 1916. Separate bids to be submitted on five-year and ten-year terms. Specifications are on file in the office of George J. Feist, chairman of lamp and watch committee, 13 South Jardin Street Shenandoah.

DOVER, N. J.—Active work has started on the construction of the proposed new power plant on the Rockaway River, near Bowlville, for the New Jersey Power & Light Company. W. S. Barstow & Company, 50 Pine Street, New York, N. Y., are managers and operators of the New Jersey Power & Light Company.

NORTH BRUNSWICK (not a post office), N. J.—Bids will be received by the township committee of North Brunswick, Red Lion Hotel, on George's Road, North Brunswick, until April 10, for lighting certain portions of streets and roads in that portion of the township adjoining the city of New Brunswick and Milltown for a period of one year from April 16. Details may be secured from Louis E. Phillips, clerk of township, or Alfred Yorston, chairman of township committee, New Brunswick.

TOMS RIVER. N. J.—The Board of Public Utility Commissioners has approved an issue of $370,000 in capital stock by the Ocean County Electric Company, the proceeds to be used for the construction of a hydroelectric plant on the Toms River, a short distance above the town of Toms River. A transmission line is to be erected to connect with the plant of the Toms River & Island Heights Electric Light & Power Company.

CUMBERLAND, MD.—Work has begun on the erection of the high-tension transmission lines of the Edison Electric Illuminating Company of Cumberland, from Lonaconing to Piedmont, W. Va. Contracts have been closed with many small towns and mining companies along the route for electrical service. Negotiations are under way with the Piedmont Electric Light & Power Company for the purchase of energy from the Edison Company. Negotiations are also under way for the extension of the high-tension lines from Piedmont to Hampshire, Shaw, Blaine, Kitzmiller, Gorman and Elk Garden, along the Western Maryland Railroad. Contracts have already been closed with several mining companies along this route and several in the vicinity of Bloomington, Garrett County.

RADFORD, VA.—A company is being organized to be known as the Enterprise Power & Manufacturing Company to construct an electric-light and power plant to develop about 10,000 hp. Oren Dodd will be general manager.

VIRGILINA, VA.—Arrangements are being made to install a municipal electric-lighting system in Virgilina. Work has begun on the erection of the transmission line.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations the following supplies: Philadelphia, Pa., Schedule 9476—14 remote control starting appliances. Brooklyn, N. Y., Schedule 9475—9 forced draft blowers; Schedule 9473—2 hoisting and rotating equipments; Schedule 9476—2 motor-generator sets. Boston, Mass., Schedule 9476—1 motor-generator set. Philadelphia, Pa., Schedule 9481—1 automobile ambulance. Newport, R. I., Schedule 9490—miscellaneous parts for air compressors, miscellaneous electrical supplies. Mare Island, Cal., Schedule 9508—miscellaneous plow steel wire rope. Washington, D. C., Schedule 9479—800 lb. brass tubing. Boston, Mass., Schedule 9502—miscellaneous cast-iron ploy steel wire; 9480—miscellaneous oil break switches, etc. Brooklyn, N. Y., Schedule 9503—5500 ft. 4-conductor cable, miscellaneous interior communication cable, miscellaneous single-conductor wire, miscellaneous twin-conductor wire; Schedule 9502 — miscellaneous telephone cable, and miscellaneous twin-conductor wire. Applications for proposals should designate the schedule desired by number.

WASHINGTON, D. C.—Foreign trade opportunities are announced by the Bureau of Commerce reports as follows: No. 20,543—An American consular officer in the United Kingdom reports that a man in his district desires to receive catalogs and price lists from American manufacturers and exporters of electric pocket lamp cases, dry batteries and bulbs for pocket lamps, electrical novelties and photographic chemicals. No. 20,557—A firm in India writes that it desires to establish commercial relations with American manufacturers of electrical supplies, motor cars and accessories, motor cycles, bicycles, etc. 20,561—A firm in Russia informs an American consular officer that it desires to receive catalogs, quotations, and full information from American manufacturers and exporters of brass and iron hand pumps, rotary centrifugal pumps, etc., steam and electrically driven pumps, etc. Correspondence may be in English. 20,565—An American consular officer in England reports that a firm in his district desires to receive catalogs and price lists from American manufacturers of electric bells and fittings, flexible wires, bell wire, electric vacuum cleaners and other household electrical supplies. 20,566—A municipal organization in Norway informs an American consular officer that it desires to receive quotations immediately from American manufacturers of iron poles for electric wires. Blue prints may be examined and further information obtained on application to the bureau or its district officers. (Refer to file No. 73,795). No. 20,583—An American consular officer in Mexico reports that a man in his district desires to receive catalogs from American manufacturers of motors and pumps, sugar and saw mill machinery, etc. No. 20.612—An American consular officer in Chile reports that a man in his district desires to communicate with American importers of tungsten, magnesium, iodine, vanadium and molybdenum. Correspondence may be in English, but is preferred in Spanish. Further information may be obtained on application to the Bureau of Foregin and Domestic Commerce, Department of Commerce, Washington, D. C., or its branch offices.

North Central

DURAND, MICH.—The water and light committee contemplate the installation of a 250-kw., 60-cycle, 1100/2200-volt generator directly connected to engine or turbine, condensers for about 600 hp. engines. and cooling tower this summer. H. F. Rosecrans is superintendent.

MUNISING, MICH.—The Electric Light & Power Company of Munising has recently completed the installation of one 200 kw., three-phase, 60 cycle generating unit and one 150 hp. boiler.

BATAVIA, OHIO. — Improvements are contemplated to the municipal electric-lighting system in the near future, including reconstruction of pole lines, overhauling switchboard, replacing arc lamps with 400-watt nitrogen-filled units and installing some lightning arresters. N. B. Dennison is secretary.

BOWLING GREEN, OHIO.—Plans are being considered for the installation of two new water tube boilers in the power plant of the Lake Erie, Bowling Green & Napo-

leon Railway Company. Clarence G. Taylor is receiver.

CANTON, OHIO.—Plans are being considered by the Canton Electric Company for the construction of two new buildings for use in connection with its power and distributing plants, one of which will be a substation to step down current brought into Canton over the lines of the American Gas & Electric Company.

CINCINNATI, OHIO.—The general contract for the construction of the new medical college buildings at the Cincinnati General Hospital has been awarded to the Westlake Construction Company of St. Louis, Mo., at $250,000. Considerable electrical and lighting equipment will be required. Energy will be supplied by the power plant of the hospital. Samuel Hannaford & Son of Cincinnati are the architects.

CINCINNATI, OHIO.—A tentative organization has been effected by the business men of Cincinnati for the purpose of securing uniform ornamental street-lighting system for the territory bounded by Main and Fourth Streets, Central Avenue and Eighth Street. It is proposed to replace the 234 arc lamps now in use with about three times as many ornamental lamp standards, each equipped with a high-candle power lamp. The extra cost is to be borne by the property owners and business men. It is also proposed to remove street obstructions, including trolley poles and anchor line supports to the buildings.

CLEVELAND, OHIO.—The Cleveland Electric Illuminating Company has applied for a permit to erect a brick, concrete and steel substation at 2497 East Fifty-fifth Street to cost about $35,000.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, City Hall, Cleveland, until April 14, for furnishing electric wire for the filtration plant at Division Avenue pumping station, Department of Utilities, Division of Water. Specifications may be obtained on application to the deputy commissioner of water, 413 Superior Avenue, City Hall.

CLEVELAND, OHIO.—The Properties Company, owner of a large block of railroad frontage at East Seventy-second Street and the New York Central, it is reported, is planning the erection of a large power plant, which, when completed, will be 500 ft. long and 160 ft. wide and will cost approximately $500,000. George S. Ridder & Company, Century Building, Cleveland, are architects and engineers.

MECHANICSBURG, OHIO.—The City Council is considering arrangements by which its present electrical service, furnished by the plant of the Long Manufacturing Company, will be changed from direct to alternating current, energy to be secured from the transmission lines of the Urbana (Ohio) Light & Power Company.

NEWTOWN, OHIO.—The town officials have decided to abandon the project to establish a municipal electric plant and have made arrangements with the Cincinnati, Milford & Loveland Traction Company to furnish electrical service in Newtown.

NORWOOD, OHIO.—Estimates submitted to the City Council for installing ornamental lamps along Montgomery Road, from Weir Avenue to the N. & W. Railroad crossing, place the cost at about $15,000.

SALINEVILLE, OHIO.—The Salineville Electric Light, Heat & Power Company is planning to install a 100-kw. alternator, already purchased. P. S. Hart is manager.

SPRINGFIELD, OHIO.—The Springfield Light, Heat & Power Company has been awarded the contract for the installation of the lighting and power system at the new Memorial Hall, and for furnishing service for the building. Most of the material has been purchased. The company is also negotiating for the contract for the lighting, heating and power systems for the new Hotel Shawnee.

BERRY, KY.—The city of Berry is considering the installation of an electric-lighting system or granting a franchise.

LA GRANGE, KY.—The new electric-lighting franchise in La Grange has been purchased by Adams & Company of Sulphur Springs for $250. Under the terms of the franchise they have eight months to make improvements to the local plant. When completed a 24-hour service will be established.

MURRAY, KY.—An election will be held May 20 to submit to the voters the proposal to issue $20,000 in bonds for the installation of a municipal electric-light plant.

PIKEVILLE, KY.—Improvements are being made to the plant of the Sandy Valley Light & Power Company, which, when completed will enable the company to furnish a 24-hour service in Pikeville.

COLUMBUS, IND.—The contract for the reconstruction of the municipal electric-light plant has been awarded to the Sanborn Electric Company of Indianapolis, at $15,980. When completed the municipal plant will supply electricity for commercial purposes.

INDIANAPOLIS, IND.—Preparations are under way for extensions and improvements to the plant of the Indianapolis Light & Power Company, this year, including the installation of a 4000-kw. Curtis turbine (36 r.p.m.) and generator, together with switchboard, condensers, etc.; also certain boilers, stokers and superheat equipment. All equipment has been purchased. The Company has recently purchased a 15,000-kw. turbine with all accompanying accessories to be installed next year. This is the beginning of a new station on the old site. Thomas A. Wynne is vice-president.

NAPPANEE, IND.—The electric light and water commissioners are contemplating rebuilding the distribution lines and changing the voltage to 2300 and transferring the lines to alleys and conduits. An additional generating unit will also be installed next fall. Myron D. Kizer is manager of light and water plant.

ROCKPORT, IND.—The Rockport Water Works Company will install a 200-hp. Babcock & Wilcox water tube boiler this month. A. H. Kennedy is secretary and treasurer.

ROCKVILLE, IND.—The Electric Light and Water Department expects to purchase a car load of poles. F. R. Calvert is superintendent.

SEYMOUR, IND.—A committee has been appointed by the Commercial Club to promote the installation of a new electric-light plant in Seymour.

UNION CITY, IND.—Plans are being considered for the installation of a new ornamental lighting system in the business district, consisting of sixty ornamental standards. Nitrogen-filled lamps will be erected in the residence district.

BEMENT, ILL.—The Bement Electric Light & Power Company has applied to the Public Utilities Commission for permission to erect and operate an electric transmission line from Bement to Ivesdale; also to construct an electric distribution system in Ivesdale. W. J. Day is manager.

BLOOMINGTON, ILL.—Arrangements are being made by the Bloomington & Normal Railway & Light Company to erect a 33,000-volt transmission line from Lexington to Chenoa, a distance of about 9 miles; to construct a substation in Lexington and to rebuild the distribution in that village, to operate at 2300 volts.

DIXON, ILL.—The Illinois Northern Utilities Company of Dixon is contemplating the installation of a 1000-kw. turbine, 200 5-kw. and 100 3-kw. 2300/220/110-volt transformers; 12 50-kw., 12 25-kw., 6 10-kw. and 6 5-kw., 13,200/2300-volt transformers and 1500 5-amp. meters and also 500 electric ranges.

FAIRBURY, ILL.—The Central Illinois Utilities Company of Paxton contemplates making some slight changes in its emergency plant in Fairbury.

GALESBURG, ILL.—Improvements are contemplated to the municipal electric-light plant, involving an expenditure of about $25,000. The work will include the installation of a 600-kw. generator and engine, three 100-lamp constant-current transformer for Mazda lamps, 300 lamps, wire, etc., and switchboard. Bonds have been voted for the above improvements, which will probably be made this summer. M. Ferry, National Life Building, Chicago, is consulting engineer and John Walsh is superintendent.

MORRISONVILLE, ILL.—The Southern Illinois Light & Power Company of Morrisonville will probably re-equip its distribution lines in this district with lighting arresters. Frank H. Stone is district manager.

MURRAYVILLE, ILL.—A franchise option to supply electricity in Murrayville has been obtained by the Central Illinois Public Service Company of Mattoon.

ROCKFORD, ILL.—The Rockford Electric Company is contemplating the installation of a 6250-kw. turbo-generator set, a 1000-kw. motor-generator set, boilers having a combined rating of 1000 hp., additions to water-softening plant and extensions to distributing system are also under consideration.

SAVANNA, ILL.—The Peoples Gas & Electric Company of Savanna contemplates the erection of 15 miles of three-phase high-tension transmission line.

CHIPPEWA FALLS, WIS.—The Wisconsin-Minnesota Light & Power Company has been awarded the contract to install an ornamental-lighting system in Chippewa Falls, at $8,111.

DELEVAN, WIS.—The Union Heat, Light & Power Company, it is reported, is planning to erect a transmission line around the north and south shores of Delevan Lake.

RICHLAND, WIS.—Plans prepared by R. H. Strang, superintendent, for the installation of additional machinery and equipment at the municipal light and water plant have been approved.

WINTER, WIS.—The installation of an electric-light plant in Winter is under consideration. James Freeley of Fifield, and others, are reported interested.

BEMIDJI, MINN.—Plans are being considered by the City Council for the installation of an ornamental lighting system in the business district. The business men will pay for the installation of the lamps and the city will maintain them.

WADENA, MINN.—Bonds to the amount of $11,000 have been voted for extensions to water and light plant, including the installation of a new 100-kw. or 200-kw., 60-cycle, 2300-volt alternator and engine or turbine, and for extensions to water mains.

BLOOMFIELD, IOWA.—The installation of new boilers in the municipal electric-light plant this summer is under consideration. Will probably use two 150-hp. or three 100-hp. boilers. R. C. Bristow is city treasurer.

DECORAH, IOWA.—The Interstate Power Company of Decorah expects to install an additional 300-kw. to 400-kw., 60-cycle, three-phase, 60-cycle, slow-speed generator (probably second hand) in an auxiliary steam generating station; also to erect extensions to its 13,200-volt transmission line with H. T. switches and meters. The company also expects to carry on an active campaign for the sale of electrically-operated washing machines this spring. W. H. Burtis is vice-president and manager.

GUTTENBERG, IOWA.—The Hope Electric Company of Guttenberg may install a new 100-hp. boiler soon. Edmund F. Williams is manager.

IMOGENE, IOWA.—Bonds to the amount of $5,000 have been voted for the installation of an electric-lighting system in Imogene.

MAQUOKETA, IOWA.—The Maquoketa Light & Power Company is contemplating the installation of a feed water heater, stokers, a 100-kw. generator and engine, directly connected, and lightning arresters. B. R. Mowery is manager.

RANDOLPH, IOWA.—At an election to be held April 10 the proposal to issue $4,500 in bonds, to secure electricity for commercial purposes, will be submitted to the voters.

PIERCE CITY, MO.—The citizens have voted to sell the municipal electric-light plant and to enter into a contract with the Ozark Power & Water Company, 414 Joplin Street, Joplin. The company has offered to purchase the municipal electric plant for $6,000, and asks for a twenty-year franchise.

FOREST RIVER, N. D.—Steps have been taken by local citizens to organize a company to install an electric-light plant to supply electricity in Forest River and later to the farmers in adjacent territory. The cost of the initial installation is estimated at $10,000. Dr. A. B. Field, I. W. Poole, Otto Bhend, and others, are interested.

PETERSBURG, N. D.—Application has been made to the Village Trustees by M. O. Topen for a franchise to install and operate an electric-light plant in Petersburg.

SHERWOOD, N. D.—The local electric-light plant, owned by C. H. Budke, has been purchased by E. T. Clark and J. Van de Eroe. The new owners, it is understood, will make improvements to the system.

HOWARD, S. D.—The Miner County Milling & Lighting Company of Howard will need a cooling tower to cool water for surface condenser of 250 sq. ft. surface, to be used in connection with unaflow engine. The City County has decided to purchase the plant of the company under a provision of franchise. The proposal will be submitted to the voters at an election to be held April 18.

OAK, NEB.—The capital stock of the Meyer Hydro Electric Power Company is capitalized at $100,000 instead of $10,000 as given in the item published in the issue of March 18.

SUPERIOR, NEB.—The electric plant of the Southern Nebraska Power and Development Company was recently destroyed by fire.

WINNEBAGO, NEB.—A committee consisting of M. S. Manfield, John Ashford and O. E. Buckley, has been appointed to take charge of the installation of an electric-light plant.

FORD, KAN.—An election will soon be called to submit to the voters the proposal to issue $5,000 in bonds for the installation of an electric distribution system. Energy will be secured from the Midland Water, Lighting & Ice Company of Dodge City.

HARVEYVILLE, KAN.—A franchise has been granted to the B. B. Fegan Company of Junction City to install an electric-light plant in Harveyville.

KANSAS CITY, KAN.—The Mayor and City Commissioners have decided to extend the electric-lighting system into the residence section not now served with electricity. The proposal to transfer $20,000 of the earnings to the extension fund has been recommended.

PRESTON, KAN.—Bonds to the amount of $15,000 have been voted for the construction of a municipal electric-light plant in Preston.

ROSEVILLE, KAN.—The B. B. Tegan Company of Junction City has been granted a franchise to install an electric-light plant in Roseville.

YATES CENTER, KAN.—The proposal to issue $70,000 to establish a municipal electric-light plant and water-works system will be submitted to the voters in the near future.

Southern States

MARSHVILLE, N. C.—The installation of an electric-light plant and other municipal improvements are contemplated by the City Council.

SPARTANBURG, S. C.—The Interborough Power Company, recently incorporated with a capital stock of $100,000, proposes to develop Hill Shoals on Tyger River, in Anchor Township. It is estimated that about 3000 hp. can be developed. A. M. Law, R. E. Boggs, C. R. Willard and W. G. Willard of Spartanburg are the incorporators.

ST. GEORGE, S. C.—Bonds to the amount of $5,000 have been voted for the installation of an electric-lighting plant.

ELLAVILLE, GA.—At an election to be held April 10 the proposal to issue $8,000 in bonds for improvements to the municipal electric-light plant will be submitted to the voters.

RINGGOLD, GA.—Improvements and extensions, it is reported, will be made to the local electric-light plant. D. Ferriss is interested.

OKEECHOBEE, FLA.—The Okeechobee Ice Company is installing electrical equipment to light its plant and is planning to supply electricity for lighting the city as soon as a franchise is granted.

ST. PETERSBURG, FLA.—Contracts, it is reported, have been awarded by the St. Petersburg Electric Light & Power Company for equipment which will practically double the output of its plant. The contract includes a 1500-kw. turbo-generator unit and necessary condensers, etc. The cost is estimated at $75,000.

DYERSBURG, TENN. — Improvements are contemplated to the municipal electric-light plant, including the installation of a unaflow engine, hot water meter, cold water meter, ornamental lamps posts, and 2 miles of pole line. A number of extensions will be made to the water-works system. S. R. Blakeman is superintendent.

LAWRENCEBURG, TENN.—The entire transmission line and local distribution system of the municipal electric system will be overhauled this spring and summer. All material has been purchased. E. P. Nixon is superintendent.

NEWPORT, TENN. — Bonds to the amount of $5,000 have been voted for the construction of an electric-light plant.

ASHLAND, ALA.—The Alabama Power Company of Birmingham has purchased the municipal electric-light plant and will supply electricity from its plant at Lock 12 on Coosa River, to operate the local system. The transmission line will be extended from Talladega to Ashland.

TUCKERMAN, ARK. — The Citizens' Light & Power Company is contemplating the installation of an electric-light plant in Tuckerman.

GLENMORA, LA.—Contracts have been awarded by the Town Council to S. Farmbacher of Baton Rouge and L. Levy of White Castle for the installation of an electric-light plant in Glenmora. The cost is estimated at $12,000.

CROWLEY, LA.—The Arcadia Iron Works, it is reported, contemplates the installation of an electric plant to supply electricity for lamps and motors for its works.

VILLE PLATTE, LA.—The City Council has engaged X. A. Kramer of Magnolia, Miss., engineer, to supervise the reconstruction of electric-lighting system and pumping station. The cost is estimated at $15,000.

BLACKWELL, OKLA. — The city of Blackwell is contemplating extensive improvements to the water works, electric-light and sewer systems, to cost about $60,000. An election will soon be called to submit to the voters the proposal to issue bonds for the work. It is proposed to rebuild the water and light plant, including the installation of new boilers and generating units, building of intake in river and the installation of an ornamental street-lighting system in the business district. The Benham Engineering Company of Oklahoma City will have charge of the engineering work.

BURLINGTON, TEX.—Plans are under way for the installation of an electric-light plant in Burlington. Equipment, it is understood, has been purchased. H. Henderson is reported interested.

DONNA, TEX.—The installation of an electric-lighting system in Donna is reported to be under consideration.

HOUSTON, TEX. — Arrangements have practically been completed between the Texas Avenue business men and the Houston Lighting & Power Company for the installation of ornamental lamps on that thoroughfare.

LOCKHART, TEX.—The Lockhart Water Works, owned by the Southern Utilities Company of San Antonio, Tex., has just completed the installation of a 100-kva., three-phase generator, and on March 1 a 24-hour service was established in all parts of the city; the 220-volt, direct-current service, now operating in the business center only, will be discontinued. A new concrete boiler and pump house for the water-works system and fire service pumps has been built. Frank E. Scovill is manager.

VICTORIA, TEX.—The City Council has engaged an engineer to prepare estimates of the cost of a municipal electric-light plant and maintenance of same. The Council has also authorized the secretary to advertise for bids for construction of a new fire alarm tower.

Pacific States

KEYPORT, WASH.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until April 29, for constructing two 400-ft. steel towers at the Pacific Coast torpedo station, Keyport, Wash. Plans and specifications may be obtained on application to the bureau or to the commandant, navy yard, Bremerton.

SEATTLE, WASH.—Plans have been completed by J. D. Ross, superintendent of lighting, for new lamp standards to be erected in Pioneer Place. The standards will be 20 ft. high mounted with four lamps.

SHELTON, WASH.—The plant of the Shelton Electric Company has been purchased by Charles A. Harmony. The name of the company has been changed to the Shelton Light & Power Company. Some improvements and extensions, it is understood, will be made by the new owner.

BAKERSFIELD, CAL.—The installation of an electrolier street-lighting system in Bakersfield is under consideration.

LOS ANGELES, CAL.—Permits have been issued for the construction of the municipal electric distributing plant to be erected at St. John and Holly Streets. The main building will be three stories and will cost about $60,000. Frederick L. Roehrig is architect.

POMONA, CAL.—Plans are being prepared for the proposed street-lighting system in Lincoln Park tract. The plans provide for the erection of 115 lamps.

SAN FRANCISCO, CAL.—The Pacific Gas & Electric Company has applied to the State Railroad Commission for authority to rent space in the North Beach power house of the Sierra & San Francisco Power Company for the purpose of installing electrical apparatus in connection with its transbay cables.

YREKA, CAL. — The California-Oregon Power Company has contracted with the Yukon Gold Company to supply energy for the dredging operations near Carlville for a period of ten years. The company is preparing to extend its service into Trinity. The transmission line will be erected into Trinity by the way of Lamoine.

WALLACE, IDAHO.—An agreement, it is reported, has been reached by the representatives of the Reindeer-Queen, Carney Copper and the Carbonate Hill Mining Companies of Wallace, whereby the Reindeer-Queen Company will install a power plant, which will supply electrical energy to the three companies. The Reindeer-Queen Company owns water rights on Willow Creek with Twin Lakes serving as a reservoir. The compressor plants and other equipment will be operated by electricity.

PROVO, UTAH.—Application has been filed by John R. Stewart of Provo for 10 cu. ft. of water from the North and South Branches of the North Fork Creek in Utah County. The application states that a dam and pipe line and water power plant will be installed for the purpose of supplying electricity for lamps and motors in Utah and Wasatch Counties.

SALT LAKE CITY, UTAH.—The State Capitol Commission is considering a proposal to illuminate the State Capitol Building by the flood lighting system; also to install a new lighting system in the capitol grounds.

FLORENCE, ARIZ. — Bonds to the amount of $50,000 have been voted for construction of municipal electric-light plant and water-works system.

MILES CITY, MONT.—Bids will be received by the Miles City Hospital, at the office of the Miles City Chamber of Commerce, until April 15 for the erection of a hospital and power house in Miles City. Plans and specifications are on file at the office of the Chamber of Commerce.

ORGAN, N. M.—Phelps, Dodge & Company of New York, N. Y., who recently purchased the Bennett-Stephenson and other mines in the Organ district, for a consideration of $1,500,000, contemplate the construction of an electric power plant and other improvements.

Canada

WINNIPEG, MAN.—Tenders will be received by the chairman of board of control, at the office of M. Peterson, secretary, Winnipeg, until April 17 for the supply of overhead and indoor construction materials for the City Light and Power Department for the period of six months from date of contract. Specifications and form of tenders, together with necessary information may be obtained at the office of the City Light and Power Department, 54 King Street, Winnipeg.

FREDERICTON, N. B.—Arrangements are being made by the Fredericton Gas Light Company for extensions of its transmission lines to the east side of the St. John River. The cost is estimated from $25,000 to $30,000.

MONTREAL, QUE.—The Civic Investment & Industrial Company, recently incorporated, it is understood, is to be the medium through an amalgamation of the Montreal Light, Heat & Power Company and the Cedar Rapids Manufacturing & Power Company will be effected in the near future. The company will start with a capital stock of $100,000, but has been granted wide powers for expansion.

SHERBROOKE, QUE.—The appropriation for extensions and maintenance of the municipal electric-light plant for the year 1916, provides for new equipment and supplies as follows: For power station in city, Tirril regulator, 3 kw. switchboard meters, 2 exciter governors, $2700; electric distributing system, poles, insulators, lightning arresters, wire, etc., $12,000; electric meters (power and light), $5,950; transformers, $7,500; electric station in Drop Off, recording switchboard panel with instruments, Tirrill regulator and 2 exciter governors, and automatic water level recording instrument, $3,660; Drop Off transmission line, $200; to complete cleaning city plant tail race and repairs to dam and flumes, $1,000; repairs to machinery, renewals of generators and exciter coils and all switchboard and connection repairs in city station, $3,500; two sets of turbines to replace old ones in Drop Off plant, $8,000; repairs and renewals on pole line for entire system, $10,000; power transformers, $3,000; light transformers, maintenance, etc., $1,500; street-lighting equipment, including lamps, brackets, wire, etc., $4,800.

It is also proposed to develop another water power this year on the St. Francis River, 17 miles from the city, where it is estimated that 6500 hp. can be developed at a cost of about $300,000.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing office, the Panama Canal, Washington, D. C., until April 20, for furnishing steel cable, asbestos gaskets, magnesia pipe covering, calcium carbide, galvanized sheet steel or iron, planish iron, malleable iron castings, etc., under circular No. 1029. Bids will also be received until April 18 for furnishing steel pipe, copper tubing, machine bolts, pulleys, etc., under circular No. 1027. Blanks and general information relating to these circulars may be obtained at the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and Fort Mason, San Francisco, Cal. Major Earl I. Brown is general purchasing officer.

1,176,739. Junction Box; C. W. Davis, Edgeworth, Pa. App. filed Jan. 11, 1913. Can be completely assembled in the shop.

1,176,759. Telephone Key; W. Kaisling, Chicago, Ill. App. filed March 7, 1907. Novel catch mechanism for maintaining keys in different positions.

1,176,762. Electric Spot Welding Apparatus; L. S. Lachman, New York City. App. filed July 14, 1915. Welding transformers located at opposite sides of the work.

1,176,767. Trolley-Operated Contact; J. F. McElroy, deceased, New York City. App. filed April 29, 1912. Novel suspension arrangement.

1,176,794. Ignition Device; H. W. Uhl, Freeport, N. Y. App. filed Aug. 21, 1915. Interpreter mechanism.

1,176,801. Insulator; W. H. Williams, Carey, Ohio. App. filed April 26, 1912. Holds wires crossing at an angle.

1,176,805. Magneto Machine; H. H. Wixon, Chicago, Ill. App. filed March 4, 1910. Stationary inductor winding having both primary and secondary coils.

1,176,809. Automatic Fire Alarm; H. and F. Barton, Endicott, N. Y. App. filed June 29, 1914. Pivoted fire-released mercury container.

1,176,814. Electric Heater; F. O. Bullis, Louisville, Ky. App. filed Sept. 2, 1914. For popping corn and roasting peanuts.

1,176,824. Telegraphic Typewriting System; P. Etienne, St. Imier, Switzerland. App. filed Aug. 19, 1911. Page-printing telegraphic receivers and transmitters (43 claims).

1,176,827. Clutch Mechanism for Traveling Cranes; J. E. Guinn, Springfield, Mo. App. filed July 24, 1915. Automatically reverses to prevent truck running off track.

1,176,829. Motor Controller; C. T. Henderson, Milwaukee, Wis. App. filed Nov. 2, 1914. Particularly designed for electric vehicles.

1,176,899. Mold or Form for Uniting Metal Pieces; C. F. Jacobs, Chicago, Ill. App. filed July 24, 1915. For uniting rail ends.

1,176,900. Sanitary Telephone Mouthpiece; E. M. Jenkins, Italy Tex. App. filed Oct. 10, 1914. Designed to take the place of the usual mouthpiece.

1,176,925. Apparatus for Radio Communication; G. W. Pickard, Amesbury, Mass. App. filed Jan. 15, 1913. Testing set which will function accurately.

1,176,927. Pin for Electrical Work; M. C. Rosenfeld, Cleveland, Ohio. App. filed Sept. 27, 1912. Hollow conical structure.

1,176,941. Automatic Switch; W. L. Bliss, Niagara Falls, N. Y. App. filed March 27, 1911. Non-chattering construction for coil lighting systems.

1,176,942. Electric Terminal Connection; W. L. Bliss, Niagara Falls, N. Y. App. filed April 13, 1912. Protected from corrosive action of the batteries.

1,176,943. Automobile Tail-Signal Switch; F. Bollinger, Akron, Ohio. App. filed Sept. 24, 1913. Pedal-operated switch.

1,176,944. Electrical Switching Apparatus; E. W. Brackett, Elyria, Ohio. App. filed April 3, 1912. Particularly for four-party selected telephone.

1,176,960. Time-Stamp Construction and System of Operation for the Same; C. I. Hall, Chicago, Ill. App. filed Feb. 12, 1912. Time-stamp is actuated by alternating current.

1,176,970. Secondary Battery; J. O. Luthy, San Antonio, Tex. App. filed July 7, 1914. Constructed to take the place of ordinary dry batteries.

1,176,984. Electric Switch; A. C. Philpott, Bucyrus, Ohio. App. filed Jan. 8, 1914. Successive movements of armature throws switch in opposite directions.

1,177,016. Switch; H. W. Cheney, Milwaukee, Wis. App. filed Nov. 20, 1909. Readily removable oil-switch construction.

1,177,025. Diaphram; J. H. Ellis, Milwaukee, Wis. App. filed April 26, 1911. Made of sheet celluloid.

1,177,043. Ignition Apparatus; W. B. McLaughlin, Brooklyn, N. Y. App. filed Dec. 30, 1913. Two-pole spark-plug construction.

1,177,044. Multiple Brush Switch; J. L. McQuarrie, Montclair, N. J. App. filed June 8, 1915. Automatic and semi-automatic systems.

Record of Electrical Patents

Notes on United States Patents issued March 28, 1916, prepared by Mitchell & Allyn, 41 Park Row, New York.

1,177,047. Machine for Transmitting Sound Over Long Distances; W. Opel, Leipzig, Germany. App. filed April 24, 1913. Soundbox has heat-insulating means.

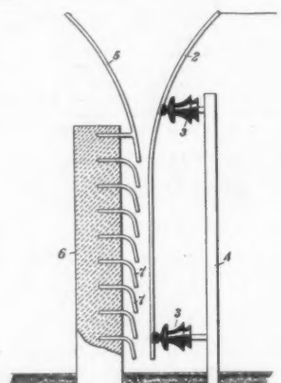
1,177,081. Railway Signal Apparatus; J. H. Alandar, deceased, Chicago, Ill. App. filed March 7, 1910. Indicates to stations approach of trains.

1,177,082. Electrical Cooking Utensil; A. B. Antisell, New York City. App. filed Oct. 2, 1915. Particularly for warming liquids.

1,177,119. Composition of Matter and Process of Making the Same; A. J. Liebmann, New York City. App. filed March 12, 1915. Mixture of carbon, copper and tungsten for dynamo brushes, etc.

1,177,139. Perforator for Master Sheets; L. R. Roberts, Rutherford, N. J. App. filed Nov. 29, 1912. Perforator punches operated by a common hammer (90 claims).

1,177,180. Grounding Device; W. R. Garton, Brooklyn, N. Y. App. filed Nov. 10, 1913. Constructed to be driven into the ground.



No. 1,177,336. Lightning Arrester

1,177,211. Combination Level and Flashlight Lamp; T. W. Ridpath, Kansas City, Mo. App. filed April 26, 1915. Special lamp and push-button arrangement.

1,177,241. Searchlight for an Umbrella or Cane Handle; S. S. Gay, Sedro Wooley, Washington. App. filed Nov. 5, 1915. Special lamp mounting and switch construction.

1,177,254. Electric Heating Device; J. Lawrence, New York City. App. filed Nov. 19, 1915. Stove with readily removable heating units.

1,177,254. Electric Heater; J. Lawrence, New York City. App. filed Nov. 19, 1915. Insures direct radiation of heat from the plate which supports the resistance coil.

1,177,255. Water Heater; J. Lawrence, New York City. App. filed Dec. 17, 1915. Flow of heating current controlled by temperature of water.

1,177,260. Apparatus for Electric Welding; T. E. Murray, New York City. App. filed Nov. 17, 1915. Current is sent through small fractions of the area welded successively.

1,177,271. Telegraph System; P. M. Rainey, Glen Ridge, N. J. App. filed Dec. 7, 1914. Automatic distribution of incoming calls to idle operators.

1,177,307. Switchboard Connecting Cord and the Like; P. P. Craven, Charlton-on-Medlock, Manchester, England. App. filed May 7, 1913. Special helical cord protector attached to plug.

1,177,310. Fuse Box; H. F. Fisher, Columbus, Ohio. App. filed Jan. 11, 1915. Enables safe inspection and renewal of

1,177,312. Spark-Coil Virbator; M. Fulton, Chicago, Ill. App. filed March 8, 1915. Special attaching regulator means.

1,177,315. Insulator; W. G. Gee, Kansas City, Mo. App. filed Sept. 29, 1914. Has pairs of retaining lugs for engaging the wires.

1,177,319. Electric Lamp Socket; G. W. Goodridge and G. B. Thomas, Bridgeport, Conn. App. filed Jan. 26, 1915. Combined socket and shade-holder construction.

1,177,328. Electric Storage Battery; H. H. Hirsch, Philadelphia, Pa. App. filed Jan. 15, 1914. Particularly designed for miners' lamps.

1,177,334. Protective Device; R. P. Jackson, Edgewood Park, Pa. App. filed Jan. 7, 1914. Automatically disconnects defective transformers from distributing mains.

1,177,335. Electrolytic Lighting Arrester; R. P. Jackson, Edgewood Park, Pa. App. filed July 24, 1914. Ground cell is subjected to normal potential of the line.

1,177,336. Lightning Arrester; R. P. Jackson, Pittsburgh, Pa. App. filed Feb. 3, 1910. Long line terminal member co-operates with plurality of short overlapping terminals.

1,177,346. Coil Terminal; J. E. Mateer, Wilkinsburg, Pa. App. filed Feb. 7, 1913. Secured in place prior to ( ) (?) the coil.

1,177,349. Induction Regulator; C. B. Mills, East McKeesport, Pa. App. filed Sept. 28, 1912. Employs continuous operating motor but no mechanical clutches.

1,177,354. Line Insulator; D. P. Ranson, Woodstock, Vt. App. filed Aug. 21, 1913. Attachably connected suspension disks.

1,177,370. Electrical System for Auto Vehicles; R. Varley, Englewood, N. J. App. filed June 17, 1912. Variations in voltage are minimized—magneto and generator system.

1,177,377. Railway Signaling; J. P. Buchanan, Cleveland, Ohio. App. filed Oct. 29, 1913. Blocks are divided into sections.

1,177,386. Gas-Lighting System; D. D. Corning, Cedar Falls, Iowa. App. filed March 23, 1915. Combined valve and switch.

1,177,392. Sheathed-Wire Terminal; J. T. H. Dempster, Schenectady, N. Y. App. filed Oct. 29, 1912. Includes insulating material held under pressure.

1,177,400. Support for Electric Wires; R. B. Duran, Torren, Mexico. App. filed Dec. 30, 1912. Switches fallen wire out of circuit.

1,177,416. Electromagnetically Controlled Mercury-Vapor Lamp and the Like; J. Jonas, Baden, Switzerland. App. filed Sept. 25, 1914. For controlling large arcs.

1,177,420. Signaling Horn; J. A. and E. L. Lannert, East Cleveland, Ohio. App. filed Jan. 29, 1915. Has an amplifying chamber.

1,177,427. Electromagnetic Switch; R. H. McLain, Schenectady, N. Y. App. filed May 12, 1911. Auxiliary winding in inductive relation to the first winding.

1,177,444. Electric Meter; W. H. Pratt, Lynn, Mass. App. filed March 18, 1914. Of few parts and easily assembled.

1,177,445. Telephone; H. Thompson, Raillieboro, South Monaghan, Ontario, Canada. App. filed July 18, 1914. Signals eavesdropping on party line.

1,177,448. Fraud Preventing Device; J. H. Rosko, Johnstown, Pa. App. filed July 17, 1915. Handcuff appliance for fire alarm devices.

1,177,485. Telephone Signal; De Forrest Champeon, Houlton, Me. App. filed Sept. 16, 1914. Detects listening in on telephone lines.

1,177,496. Ignition System for Hydrocarbon Engines; L. Davis, Rich Hill, Mo. App. filed April 26, 1915. Simplified wiring with single vibrator.

1,177,547. Storage Battery; A. H. Snyder and R. L. Buck, Lancaster and Buffalo, N. Y. App. filed July 22, 1914. Special sealing and ventilating means.

1,177,548. Rectifier; J. E. Southwick, Atlantic, Iowa. App. filed May 27, 1914. For changing alternating current of magneto to direct current.

1,177,551. Electric Railway System; J. B. Strauss, Chicago, Ill. App. filed March 30, 1908. Third-rail is energized only upon passage of car.

14,096 (Reissue). Automatic Trunking System; E. A. Nellinger, Chicago, Ill. App. filed Feb. 1, 1915. Original No. 1,110,071, dated Sept. 8, 1914. Common trunks are maintained in reserve "for overload" (61 claims).